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Surface Combustion.

[From the Second Howard Lecture by PROF. W. A. BONE, delivered before the Royal Society of Arts, London.]

Last week I reviewed the consideration which convinced me of the possibility of realizing, in practically applicable forms, and by means of common refractory materials, the basic conception of flameless incandescent surface combustion, I now propose to describe the experimental development of two new processes embodying this principle, but should like to preface my discourse with a short historical statement.

It was in 1906, after the publication of the first installment of my scientific researches in conjunction with Mr. R. V. Wheeler, that I decided to develop my ideas technically at the first favorable opportunity, and in December of that year I made a provisional arrangement with Messrs. Wilsons and Mathiesons, Ltd., to co-operate with them on the matter. Before, however, we had proceeded very far, an unlooked-for intervention occurred in 1907.

When I resumed my interrupted co-operation with Messrs. Wilsons and Mathiesons, October, 1909, Mr. C. D. McCourt became associated with the enterprise; and, with his assistance, steps were at once taken to attack the problem systematically from the industrial standpoint.

Before any further experiments were made, I deposited with a bank on October 16, 1909, a signed statement in a sealed envelope, which was not opened until October 23d, 1913, defining the nature of the problem, and my proposed solution of it, in the following terms:

"To bring a combustible mixture of gas and air in suitable proportions into contact with the interstices of an incandescent porous solid or suitable composition and porosity in such a manner as to produce a flameless, or as nearly as may be a flameless surface or interstitial combustion, whereby the porous solid shall be maintained in a continual state of incandescence."

How closely the realization of the phenomenon, in the two processes which I propose to describe and illustrate, has corresponded to this original definition of it, I leave you to judge; but I wish to place this definition on record, as evidence of the precise position to which the scientific researches in the laboratory had led us before industrial investigation had begun.

The new system of incandescent surface combustion, known as the "Bonecourt" system, which was evolved under my direction during the three following years, consisted principally of two processes, in which a homogeneous explosive mixture of gas and air, in the proper proportions for complete combustion (or with air in slight excess), is caused to burn without flame in contact with a granular incandescent solid, whereby a large proportion of the potential energy of the gas is immediately converted into radiant form.

The advantages claimed for the new system are: (1) The combustion is greatly accelerated by the incandescent surface, and, if so desired, may be concentrated just where the heat is required; (2) the combustion is perfect with a minimum excess of air; (3) the attainment of very high temperatures is possible without the aid of elaborate heat recuperative and regenerative devices; and (4) owing to the large amount of radiant energy developed, transmission of heat from the seat of combustion to the object to be heated is very rapid. These advantages are so uniquely combined in the new system that the resultant heating effect is for many important purposes not only preeminently economical but also easy of control.

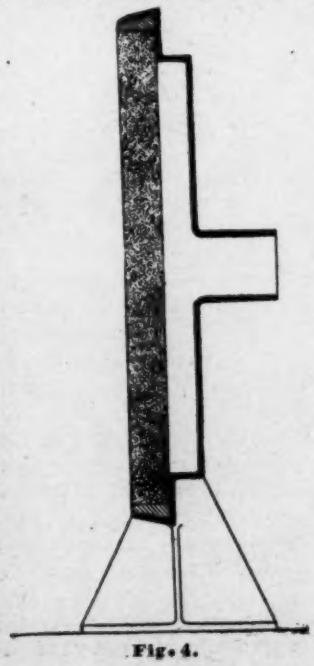

Fig. 4.

Diaphragm Heating and its Applications.—In the first process the homogenous mixture of gas and air is allowed to flow under slight pressure through a porous diaphragm of refractory material from a suitable feeding chamber (see Fig. 4) and is caused to burn without flame at the surface of exit, which is thereby maintained in a state of incandescence. The diaphragm is composed of granules of firebrick, or other material, bound together into a coherent block; the porosity of the diaphragm graded to suit the particular gas for which it is to be used. The diaphragm is mounted in a suitable casing, the space enclosed between the back of the casing and the

diaphragm constituting a convenient feeding-chamber for the gaseous mixture which is introduced at the back. Such a mixture may be obtained in either of two ways, namely, (1) by means of suitable connections through a Y-piece with separate supplies of low-pressure gas and air (2 or 3 inches W.G. is sufficient), or (2) by means of an "injector" arrangement connected with a supply of gas at a pressure of 1 to 2 pounds per square inch; the gas in this case draws in its own air from the atmosphere in sufficient quantity for complete combustion, the proportions of gas and air being easily regulated.

We will now start up a diaphragm. Gas is first turned on and ignited as it issues at the surface; air is then gradually added until a fully aërated mixture is obtained. The flame soon becomes non-luminous, and diminishes in size; a moment later it retreats to the surface of the diaphragm, which at once assumes a bluish appearance; soon, however, the granules at the surface attain an incipient red heat, producing a curious mottled effect; finally, the whole of the surface layer of granules becomes red hot, and an accelerated "surface combustion" comes into play. All signs of flame disappear, and there remains an intensely glowing surface throwing out a genial, radiant heat.

Whilst the diaphragm is in operation I may point out some of the more striking features of the phenomenon. I. The actual combustion is confined within a very thin layer—¼ to ½ inch immediately below the surface, and no heat is developed in any other part of the apparatus; the back of the apparatus is so cold that I can lay my hand on it. II. The combustion of the gas, although confined within such narrow limits, is perfect, for when once the proportions of gas and air is properly adjusted, no unburnt gas escapes from the surface. III. The temperature at the surface of the diaphragm can be instantly varied by altering the rate of feeding of the gaseous mixture; there is practically no lag in the temperature response, a circumstance of great importance in operations where a fine regulation of heat is required. IV. A plane diaphragm such as this may be used in any position, *i. e.*, at any desired angle between horizontal and vertical. V. The diaphragm method is amenable to a variety of combustible gases; coal or coke-oven gas, natural gas, petrol-air gas, carburetted water gas, are all well suited in cases where unimpeded radiation is required. Finally, the incandescence in no way depends upon the external atmosphere. When once the diaphragm has become incandescent, and the proportions of air and gas properly adjusted, the surface will maintain its incandescence even in an atmosphere of carbon dioxide.

I do not point out to you the many obvious purposes, domestic and industrial, to which "diaphragm heating" may be applied. In the domestic line the boiling of water, grilling, roasting, and toasting, are at once suggested; and, although the best existing types of gas fires are thoroughly hygienic and efficient, I think that the diaphragm may come in for the heating of apartments.

I have been told of a restaurant in London where they are grilling by means of an electric radiator fixed above the work so that the radiant energy is directed downwards on to it. It is claimed that the value of the recovered fat, which in the ordinary method drops into the fire and is consumed, has more than paid for the electricity used. With a diaphragm, similar advantages can be secured with gas at a considerably less cost; for comparing gas of 500 B.T.U. per cubic foot at 2s. 6d. per 1,000 cubic foot with electricity at 3d per unit, the cost of a given amount of energy is about fourteen times greater in the form of electricity than in the form of gas.

Not long ago I visited a candy factory where diaphragms have been employed for more than a year for the boiling and concentrating of sugar solutions. The solution is boiled in a copper pan over a 13-in. diameter circular diaphragm (Fig. 5); the supply of gaseous mixture is controlled by one lever which operates the gas and air cocks. Ignition is effected by a pilot light. Each boiler does 10 to 12 heats per diem, each lasting 20 minutes, and some of the diaphragms have been in continuous daily use for a year. They have 13 such boiling pans in constant use, and the gas consumption is not more than half what it was when the pans were heated over ordinary atmospheric flame burners. The secret of this higher efficiency lies in the fact that gas flames are a very unsatisfactory means for boiling liquids in metallic vessels, owing to the non-conducting layer of relatively cool gas which forms between the flame and the undersurface of the pan; but with a diaphragm the large percentage of radiant heat is quickly absorbed by the vessel and transferred to the liquid with high efficiency.

Another interesting application of diaphragm heating is for the evaporation and concentration of liquids by means of downward radiation from a diaphragm above the surface of the liquid. By this process, only the topmost layers of the liquid are heated; the radiant energy from the incandescent diaphragm is transmitted to the surface of the liquid, where it is absorbed and utilized for evaporation. The material separates out as a surface skin; it is then dried by the radiant heat, and at intervals the dry crust may be skimmed off. The advantages of such a method for the evaporation of liquids are obvious, but, of course, its commercial development is primarily a question not so much of actual thermal economy as of the cost of gaseous fuel compared with coal. Thus, with coal at 12s. per ton and coal gas at 1s. per 1,000 cubic feet, the cost of a given number of heat units is about four and a half times as great in the form of gas than in coal, although the greater economies and other advantages obtainable with gas largely wipe out the difference in final cost. In localities near coking plants, coke oven gas should be obtainable at a price which would make this particular use of the diaphragm a commercial proposition.

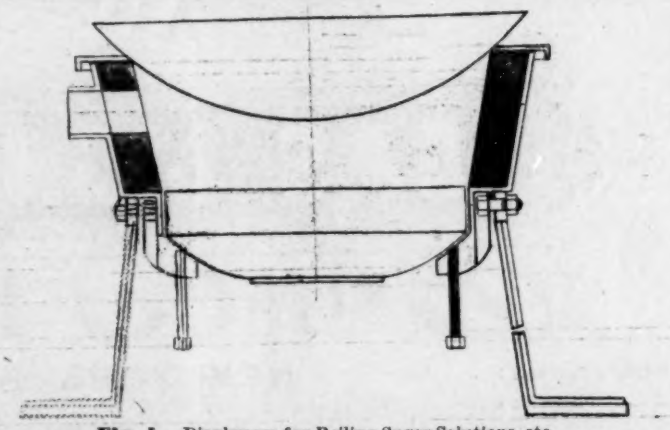

Fig. 5.—Diaphragm for Boiling Sugar Solutions, etc.

Surface Combustion in a Bed of Refractory Granular Material.—This process is applicable to all kinds of gaseous or vaporized fuels, and consists essentially in injecting, through a suitable orifice at a speed greater than the velocity of back-firing, an explosive mixture into a bed of incandescent granular refractory material, which is disposed around or in proximity to the body to be heated.

Fig. 6 shows the process as applied to a crucible furnace, the crucible surrounded by a bed of refractory incandescent granular material. The mixture of gas and air is injected at a high velocity through an orifice at the base of the furnace, and as it impinges upon the incandescent bed combustion is instantaneously completed without flame. The seat of this active surface combustion is in the lowest part of the bed; the burnt gases, rising through the upper layers, rapidly impart their heat to the bed, maintaining it in a high degree of incandescence.

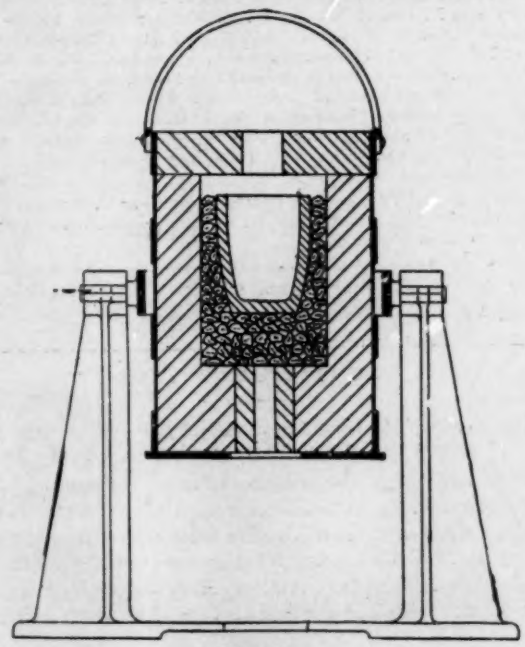

Fig. 6.

It is obvious that this process is capable of adaptation to all kinds

of furnace operations, the heating of crucibles, muffles, retorts, and to annealing and forging furnaces generally. Moreover, it is not essential that the bed of refractory material be very deep; quite a shallow bed suffices to complete the combustion. Neither is it necessary the bed be disposed *around* the vessel or chamber to be heated; for if contact with the burnt products is not objectionable, a shallow bed may be arranged *within* the heating-chamber itself; or the refractory material may be equally well packed into tubes or the like, traversing the substance or medium to be heated. The last-named modification is specially important in relation to steam-raising in multitubular boilers.

To demonstrate the application of this process to furnace operations we will start up the small muffle furnace. We first turn on the gas and light it as it issues from the hole in the cover of the furnace; the air supply is then gradually opened until the flame strikes back through the granular material in which the muffle is imbedded until it is arrested at the orifice in the base of the furnace through which the explosive mixture enters. The flame quickly raises the granules in the neighborhood of this orifice to a state of incandescence, when "surface combustion" supersedes the flame. As soon as the lower regions of the granular bed have become thoroughly incandescent, the rate at which the mixture is being fed may be materially increased, so that in a few minutes the whole of the bed is incandescent.

By means of this process much higher temperatures are attainable with a given gas than by the ordinary methods of flame combustion without a regenerative system, and, as a matter of fact, we have found that with any gas of high calorific intensity the upper practical temperature limit is determined by the refractoriness of the material composing the chamber to be heated (*i. e.*, the muffle or crucible) rather than by the possibilities of the combustion. When I tell you that in a crucible fired by coal gas on this system we have melted Seger-cone No. 39, which melts at 1880° C. (3416° F.), and also that we can easily melt platinum, you will appreciate the possibilities of the method.

The maximum temperature obtainable, without "regenerative" appliances, with any particular gas will obviously depend upon the relative heat capacities of their products of combustion for a given heat development in the bed. In this connection it is of interest to compare the principal gaseous fuels available for industrial operations in the order of their calorific intensities.

Combustion of Typical Gaseous Fuels.

	Per Cubic Foot of Gas Burned.			Per 100 B.T.U's *net* Developed on Combustion.			
	Net B.T.U.	Vol of Air Required.	Vol. of Products	Vol. of Air Required.	Vol. of Combining Mixtures.	Vol. of Products.	Relative Heat Capacities of Products.
Blue water gas	290	2.290	2.82	0.79	1.14	0.97	0.95
Coal or coke oven gas	500	4.656	5.36	0.93	1.13	1.08	1.00
Producer gas.....	140	1.166	2.00	0.84	1.50	1.43	1.38
Blast furnace gas... .	100	0.716	1.58	0 72	1.72	1.58	1.52

Now, whilst with coal gas, coke-oven gas, or water gas, it should be easily possible, without regeneration, to obtain in a refracting granular bed temperatures of up to at least 2000° C. (or say 3630° F.), with a low-grade producer gas, such as Mond gas, about 1500° C., would probably be the approximate maximum without regeneration. With some degree of heat recuperation, which in large furnaces is quite practicable, still higher temperatures would be attainable.

The heating also within the maximum limits, with any kind of gas is very uniform, economical, and easily controlled. Indeed the temperature for a given furnace fired by a gas of given uniform quality is chiefly determined by the amount of gas burnt per unit time in the bed, or, in other words, by the rate of heat development in the bed.

In order to give you some idea of the thermal efficiency as compared with the ordinary methods of flame heating, I give below results of a test on a surface combustion furnace in which a muffle 9½ inches long by 5½ inches wide by 3½ inches high was maintained at temperatures between 815° and 1,425° C. with coal gas of 540° B.T.U. (net).

Observe that the temperature of the products is 300° to 350° C. lower than that of the muffle, and that even with a muffle temperature of 1,424° C. there was no appearance of flame at the top of the furnace. The gas consumptions recorded are extremely economical in comparison with those required for ordinary heating by daily contact. In a similar test with a muffle of the same size heated by flame contact, the gas consumption to maintain the muffle at 1,055° C. (the maximum temperature obtainable) was 105 cubic feet per hour, whereas consumption on the surface combustion furnace at the same temperature would have been about 43 cubic feet per hour. The results of these and other similar tests carried out 3 years ago in Leeds, upon medium sized muffle furnaces proved that to maintain a given temperature between 800° and 1,400° C. a properly constructed surface combustion furnace required from 70 to 40 per cent. only of the gas used in an ordinary flame heated furnace of the same dimensions. The advantage in favor of surface combustion increases with the working temperature.

Temperature in Middle of Muffle.		Gas Consumption to Maintain Temp. Constant Cubic Feet per Hour at 15° C.	Temperature of Products	
Degs. C.	Degs F.		Degs. C.	Degs F.
815	1,499	21.0	540	1,004
1,004	1,840	35.3	645	1,193
1,205	2,201	58.0	870	1,598
1,424	2,595	79.0	1,085	1,985

This conclusion was confirmed by independent trials in New York shortly after my lecture there in 1911, in which a surface combustion muffle furnace was pitted against the best American types of similar dimensions, with the result that to maintain a temperature of 1,400° C. we practically halved their gas consumption, whilst to maintain 800° C. our consumption was about 0.7 of theirs.

In large muffle furnaces regenerative arrangements may advantageously be added. By way of example, I show a regenerative furnace (Fig. 7) for the heating of a muffle chamber 8 feet by 3 feet by 3

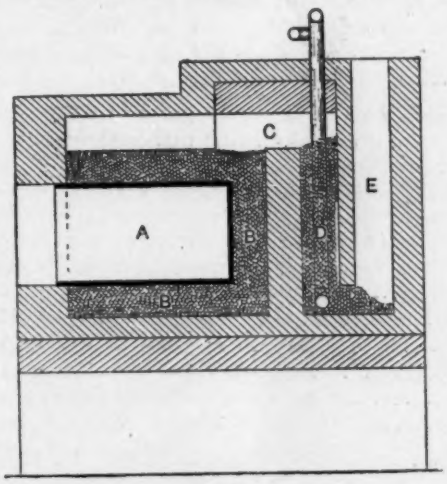

Fig. 7.

feet, which was successfully fired by coal gas at our experimental station in 1912, the air supply being pre-heated to 300° C., by the sensible heat of the waste gases leaving the combustion bed. The mixture of coal gas and pre-heated air was fed in at the front end of the furnace, and burned flamelessly in contact with a bed af incandescent granular material surrounding the muffle chamber *A*; the hot products of combustion leaving the bed were then led downwards through a second granular bed disposed round a system of iron pipes through which the air supply was fed. By means of this device we were able to maintain the muffle at 1,000° C. while the waste gases left the system at less than 200° C.

Fig. 8 is another type of furnace for high temperature operation, in which the heating is effected by means of two parallel granular beds along each side of the working space, which is therefore filled with the burnt gases. The latter are then led away through a flue vent at the back, downwards under the floor of the working space, and from thence are discharged into the atmosphere.

This type of furnace can also be combined with a simple heat recuperative system, and as an example of what can be done with such a combination, I give the results of a trial run with a furnace (working space 3 feet 1 inch by 3 feet 2 inches by 1 feet 6 inches), fired by washed producer gas (generated from anthracite) of average *net* calorific value 139 B.T.U., both gas and air being regenerated.

The furnace having been started up, systematic observations of (*a*) rate of gas consumption, (*b*) furnace temperature, and (*c*) temperatures of the hot air and hot gas leaving the generator tubes, as well as of the burnt product finally leaving the system, were made at in-

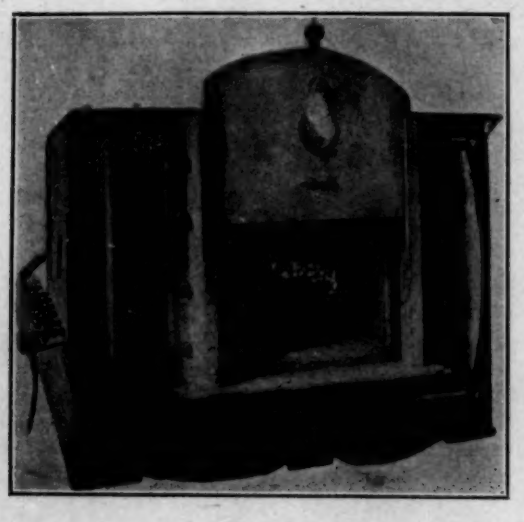

Fig. 8.

tervals throughout the day, until a temperature of 1,400° C., had been reached and maintained for a couple of hours.

Hour.	Rate of Gas Consumption. Cubic Feet per Hour.	Furnace Temperature, Degs. C.	Temperature of Hot Gas. Degs. C.	Temperature of Hot Air. Degs. C.	Temperature of Burnt Products. Degs. C.
9.35 A.M.....	7,360	800	105	148	172
10.0	7,280	985	129	191	206
11.0	6,720	1,220	184	264	283
12.0 noon.....	6,280	1,305	261	309	328
1.30 P.M.....	4,920	1,365	295	...	...
3.45.....	5,200	1,410	320	..	400
5.0	4,920	1,395	...	...	390

From analyses of (*a*) the producer gas and (*b*) the burnt products leaving the system it will be seen (1) that combustion was practically perfect with only a small excess of air, and (2) that the products finally left the system at a temperature 1,000° C. *below* that of the furnace.

Analyses of the Producer Gas.

	10 A.M.	Noon.	3 P.M.	Mean.
CO_2.....	5.8	6.4	4.7	5.60
CO.....	22.6	23.3	25.0	23.60
H_2.....	15.4	15.7	15.4	15.50
CH_4.....	1.4	1.4	1.7	1.50
O_2.....	1.2	1.0	1.2	1.15
N_2.....	53.6	52.2	52.0	52.65

Analyses of Burnt Gases Leaving Furnace.

	10 A.M.	Noon.	3 P.M.	Noon.
CO_2.....	16.4	16.7	17.0	16.70
CO.....	0.3	0.2	0.2	0.23
O_2.....	2.0	2.4	2.0	2.13
N_2.....	81.3	80.7	80.8	81.94

The primary difficulty, met with in all high temperature work is finding suitable refractory materials to withstand the fierce combustion. Then there are problems connected with feeding and distribution of the gaseous mixture, with the arrangemeut and dimensions of the combustion beds, and the contour of the furnace, all of which must be solved for each type of industrial requirement. Moreover, would-be designers and users of surface combustion furnaces must acquire an understanding of what surface combustion really is before they can realize fully its possibilities; and people whose experience has been on the old system of flame heating must be prepared to unlearn a good deal and revise their notions. A new and sound principle *wrongly* applied may give no better (if as good) results as a familiar and yet inferior principle *rightly* applied; everything depends upon right application which knowledge and right understanding alone ensure.

Nevertheless, judging from reports that reach me from time to time, substantial progress has been, and is being made in the direction of gas-fired, tilting crucible furnaces for brass and aluminium melting, annealing and forging furnaces, which, I am given to understand, are now running satisfactorily in industrial establishments on both Mond gas and town's gas.

I now come to an interesting modification of the "granular bed" process, as applicable to the continuous melting of easily fusible metals such as lead or type metal, in which the granular material is packed into tubes traversing the medium to be heated. The experiments I am about to describe refer to lead melting and were carried out in Leeds under my direction, and the method is, in principle, the same as employed in the "Bonecourt" boiler.

Fig. 9 represents an iron tank, efficiently lagged and filled with

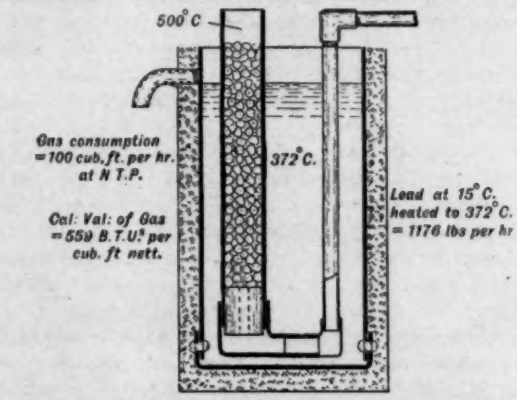
500° C
Gas consumption = 100 cub. ft. per hr. at N.T.P.
372° C.
Cal: Val: of Gas = 559 B.T.U.s per cub. ft nett.
Lead at 15° C. heated to 372° C. = 1176 lbs per hr

Fig. 9.

molten lead at a temperature some 50° C. above its melting point. In the molten bath is a vertical iron tube, 3 feet long and 3 inches in internal diameter, packed with granular refractory material. At the bottom of the tube is a tightly fitting cylindrical plug of refractory material, with a circular ¾-inch passage for the admission of the explosive mixture of gas and air, which is caused to burn flamelessly as it impinges upon the incandescent granular material above the plug; the burnt products pass upwards through the remainder of the packing, imparting their residual heat to the bath, and finally exit through the open end of the tube at about 130° C. only above the temperature of the metal in the bath. Solid lead is fed continuously into the tank, and the molten metal is run over through the spout.

The following are results of a trial run:

Lead Melting Test.

	Degs. C.	Degs. F.
Temperature of metal charged.....	15	60
Temperature of metal tapped.....	372	702
Temperature of gases leaving apparatus.....	500	932

Lead melted per hour = 1,176 pounds.
Gas burnt per hour = 100 cubic feet.
Net calorific value of gas = 559 B.T.U.

Lead ingots, weighing about 30 pounds, were added at intervals of 1½ minutes, and the molten metal displaced was simultaneously run off into moulds. Care was taken to keep the bath thoroughly molten and at a temperature within a few degrees of the mean value. Burning gas net calorific value 559 B.T.U., 100 cubic feet per hour, it was possible to raise the temperature of 1176 pounds of lead per hour from 15° to 372° C., the temperature of the products of combustion leaving the tube keeping constant at 500° C., or only 128° above the temperature of the molten metal. From the latest determination of the specific heat of lead at temperatures up to and above its melting point, and adopting the usually accepted value for the latent heat of fusion, I calculate that the heat required to raise the temperature of 1 pound of lead from 15° C. to 372° C. (including melting(is 32-67 B.T.U. Therefore the heat transmitted to the lead per hour was 38,420 B.T.U.; and the net calorific value of the gas was 55,900, the ratio $\frac{38,420}{55,900} = 0.686$. However, as the net heat of combustion of the gas is based on the assumption that the products of combustion (less steam) are cooled down to 15° C., whereas in the experiment the temperature of the molten metal was 372° C., it follows that the high ratio of 0.686 does not do full justice to the merits of the system. Under "ideal" conditions, the temperature of the gases leaving the combustion tube could not have been reduced to below 372° C.; it was actually reduced to within 130° of this "ideal" limit. Taking these circumstances into consideration, I calculate that the efficiency of the melting operation was practically 80 per cent. of that theoretically possible.

The Massachusetts State Harbor and Land Commission has received a petition from the Springfield Gas Light Company asking for permission to run a pipe out into the Connecticut River for the purpose of supplying its plant with water.

Resistance to Corrosion of Iron and Steel.

A committee of the American Railway Engineering Association has been engaged for two years on a series of tests to determine the relative resistance to corrosion of various samples of iron and steel, and the results are of special interest in view of the widely published claims concerning the resistance to corrosion of certain brands of iron and steel of special chemical composition.

A report of the tests was presented at the annual meeting of the association in March, and, since that time, they have been continued so that the results are now available from a 12-month exposure of the samples. The results indicate that corrosion proceeds at a substantially uniform rate on all kinds of rolled iron and steel, no matter what its composition.

In the tests beginning May 1, 1913, seven samples of iron and steel were selected, as follows:

No. 1. Charcoal Iron.
No. 2. Openhearth steel.
No. 3. Openhearth steel, consisting of 0.40 per cent. of copper.
No. 4. Openhearth steel, containing 1.00 per cent. of copper.
No. 5. Ingot iron.
No. 6. Same as No. 3, except as to preliminary surface preparation.
No. 7. Same as No. 4, except as to preliminary surface preparation.

Each sample included four pieces, each ¼ inch thick, 2 inches wide, and 2 to 3 inches long,

In the following analysis, the figures in the first column are as given by the mannfacturers, and in the second by S. W. Parr, Professor of Applied Chemistry:

No. 1.—*Charcoal Iron.*

	Chemical Analysis by Makers,	Parr, Per Cent.
Carbon		0.041
Manganese		0.205
Phosphorous	No	0.049
Sulphur	analysis.	0.032
Copper		0.00
Silicon		0.033

No. 2.—*Open Hearth Steel, Manufactured by the Carnegie Steel Co.*

	Per Cent.	Per Cent.
Carbon	0.15	0.144
Manganese	.037	0.394
Phosphorous	0.037	0.038
Sulphur	0.037	0.039
Copper	Trace	0.00
Silicon	0.00	0.036

No. 3.—*Open Hearth Steel, Manufactured by the Carnegie Steel Co.*

	Per Cent.	Per Cent.
Carbon	0.12	0.141
Manganese	0.38	0.418
Phosphorous	0.020	0.037
Sulphur	0.032	0.028
Copper	0.40	0.43
Silicon	0.00	0.021

No. 4.—*Open Hearth Steel, Manufactured by the Carnegie Steel Co.*

	Per Cent.	Per Cent.
Carbon	0.15	0.139
Manganese	0.45	0.492
Phosphorous	0.023	0.038
Sulphur	0.033	0.034
Copper	1.00	0.98
Silicon	0.00	0.033

No. 5.—*Ingot Iron, Manufactured by the American Rolling Mill Co.*

	Per Cent.	Per Cent.
Carbon	0.012	0.030
Manganese	0.025	0.180
Phosphorous	0.006	0.017
Sulphur	0.028	0.056
Copper	0.042	0.00
Oxygen	0.035	0.00
Nitrogen	0.004	0.00
Silicon	Trace	0.014

No. 6. Quality, manufacture and analysis the same as No. 3.
No. 7. Quality, manufacture and analysis the same as No. 4.

Five corrosive mediums were selected as follows:

No. 1. Clean sand.
No. 2. Clay soil, to which 5 per cent. of salt by weight was added.
No. 3. A mixture of equal parts of white and black alkali soils.
No. 4. Bituminous coal cinders.
No. 5. Cooking water in the overflow tank from the furnace water jackets of the Copper Queen Consolidated Mining Co., Douglas, Ariz.

Analysis of the corrosive mediums are as follows:

No. 1.—*Sand.*

	Per Cent.
Silica	82.31
Oxide of aluminum	9.44
Oxide of iron	2.98
Calcium oxide	1.86
Magnesium oxide	0.45
Oxides of sodium and potassium	3.18
Oxide of manganese	Trace
	100.22

No. 2.—*Clay Soil Plus 5 Per Cent. Salt.*

	Per Cent.
Water	5.89
Silica	54.34
Oxide of aluminum	14.33
Oxide of iron	3.71
Calcium oxide	5.10
Magnesium oxide	2.15
Oxides of sodium and potassium	10.17
Oxide of manganese	0.11
Sulphuric acid, combined	0.95
Chlorine, combined	2.83
Carbonic acid, combined	2.05
Phosphoric acid, combined	0.16
	101.79

No. 3.—*White and Black Alkali Soil.*

	Per Cent.
Water	5.10
Silica	48.46
Oxide of aluminum	8. 6
Oxide of iron	2.00
Calcium oxide	9.45
Magnesium oxide	1.37
Oxides of sodium and potassium	11.10
Oxide of manganese	0.04
Sulphuric acid, combined	9.64
Chlorine, combined	3.64
Carbonic acid, combined	2.26
Phosphoric acid, combined	0.06
	101.88

No. 4.—*Cinders.*

	Per Cent.
Volatile matter	5.44
Fixed combustion carbon	24.60
Silica	41.06
Oxide of aluminum	24.76
Oxide of iron	1.54
Calcium oxide	1.60
Magnesium oxide	0.42
Oxides of sodium and potassium	1.22
Oxide of manganese	0.02
Sulphuric acid, combined	0.50
Chlorine, combined	Trace
Phosphoric acid, combined	0.07
	101.23

No. 5.—*Water in Settling Tank.*

	Per Cent.
Alkalinity in $CaCO_3$, parts in 100,000	21.00
Hardness in grains per U. S. gallon	3.50
Total solids	57.88
Silica	1.17
Iron oxide and alumina	0.47
Calcium carbonate	0.40
Magnesium carbonate	0.42
Sodium carbonate	14.00
Sodium sulphate	16.80
Sodium chloride	25.20

The sand, clay soil, alkali soil and the cinders were placed in aluminum pans, 4 inches deep, 11 inches wide and 16 inches long in the clear. The pans are numbered 1, 2, 3 and 4, and the settling tank at Douglas, No. 5, corresponding to the numbers designating the corrosive mediums. These pans are kept on the balcony of one of the south windows of the seventh floor of the office building of the El Paso & Southwestern R.R. Co., El Paso, Tex. Exposed to sunlight and air, and the materials in them are periodically saturated with water, thereby being alternately wet and comparatively dry, duplicating in a general way service conditions of iron buried in the ground with a light covering.

In each pan a piece of each sample, No. 1 to No. 7 inclusive, is placed, with the exception of pan No. 5 at Douglas, in which samples Nos. 6 and 7 were not included. The pieces are buried in the corrosive medium by forcing them down edgeways to the middle of the depth of the pan, the pieces standing side by side about 2 inches apart. As this places one piece of each sample of iron or steel in each pan, it makes the corrosive test strictly comparable throughout for all the corrosive mediums.

Each sample was prepared for the test by carefully filing off all surface oxidation until only clean, bright metal showed over all surfaces, including the edges, with the exception of samples Nos. 6 and 7. The original surfaces of samples 3, 4, 6 and 7, containing copper, were covered with a distinct copper-colored oxidation. This oxidation was left on 6 and 7 to determine its effect in resisting corrosion, as compared with samples Nos. 3 and 4, from which the surface oxidation was completely removed.

After being prepared as above, each sample piece was weighed on a metric scale measuring to 1 centigram, and then immediately immersed in the corrosive mediums. It was decided to clean and weigh the samples at the end of each three months' period, and the loss in weight in grams per square inch of exposed surface was chosen as the unit for corrosive comparison.

It has been found that the corroded samples may be thoroughly cleaned of the corrosive action, leaving the clean metal, by immersing in a 10 per cent. solution of ammonium citrate, and this method of cleaning was adopted. In this connection, and at the first cleaning, a clean piece of uncorroded iron was also immersed in the solution in order to determine if the latter itself would produce any loss of weight in the metal. Subsequent weighing of this control piece shows no loss, and the ammonium citrate appears to be a satisfactory medium for cleaning.

In the following tables, the corrosion is measured in loss of weight in grams per square inch of exposed surface and edges:

Pan No. 1.—Clean Sand.

Sample No.	In 3 Mo.	In 6 Mo.	In 9 Mo.	In 12 Mo.
1—Charcoal iron	0.41	0.96	1.34	1.73
2—Carnegie plain O. H. steel	0.42	0.86	1.21	1.56
3—Carnegie 0.4 per cent. copper O.H. steel	0.45	0.87	1.24	1.66
4—Carnegie 1.0 per cent. copper O.H. steel	0.45	0.90	1.25	1.61
5—Ingot iron	0.43	0.87	1.23	1.61
6—Same as No. 3 not filed.	0.34	0.90	1.28	1.61
7—Same as No. 4 not filed.	0.31	0.84	1.21	1.58

Pan No. 2.—Clay Soil + 5 per cent. Salt by Weight.

Sample No.	In 3 Mo.	In 6 Mo.	In 9 Mo.	In 12 Mo.
1—Charcoal iron	0.13	0.34	0.51	0.85
2—Carnegie plain O.H. steel	0.14	0.32	0.53	0.72
3—Carnegie 0.4 per cent. copper O.H. steel	0.20	0.44	0.71	0.95
4—Carnegie 1.0 per cent. copper O.H. steel	0.14	0.34	0.60	0.84
5—Ingot iron	0.16	0.41	0.66	0.87
6—Same as No. 3 not filed	0.13	0.35	0.66	0.86
7—Same as No. 4 not filed.	0.14	0.32	0.62	0.85

Pan No. 3.—White and Black Alkali Soils.

Sample No.	In 3 Mo.	In 6 Mo.	In 9 Mo.	In 12 Mo.
1 - Charcoal iron	0.06	0.13	0.15	0.20
2 - Carnegie plain O.H. steel	0.06	0.14	0.16	0.20
3—Carnegie 0.4 per cent. copper O.H. steel	0.06	0.14	0.17	0.22
4—Carnegie 1.0 per cent. copper O.H. steel	0.06	0.15	0.17	0.22
5—Ingot iron	0.07	0.16	0.18	0.23
6—Same as No. 3 not filed.	0.04	0.12	0.18	0.23
7—Same as No. 4 not filed.	0.04	0.10	0.15	0.23

Pan No. 4.—Cinders.

Sample No.	In 3 Mo.	In 6 Mo.	In 9 Mo.	In 12 Mo.
1—Charcoal iron	0.76	1.23	1.64	2.00
2—Carnegie plain O.H. steel	0.89	1.38	1.73	2.09
3—Carnegie 0.4 per cent. copper O.H. steel	0.78	1.34	1.70	2.04
4—Carnegie 1.0 per cent. copper O.H. steel	0.78	1.21	1.59	1.93
5—Ingot iron	0.71	1.23	1.60	1.95
6—Same as No. 3 not filed	0.43	0.93	1.29	1.72
7—Same as No. 4 not filed.	0.58	1.18	1.59	1.89

Pan No. 1.—Water in Overflow Tank from Water Jackets.

Sample No.	In 3 Mo.	In 6 Mo.	In 9 Mo.	In 12 Mo.
1—Charcoal iron	1.68	2.188	2 83	3.13
2—Carnegie plain O. H. steel	1.62	2.172	2.76	3.04
3—Carnegie 0.4 per cent. copper O. H. steel	1.82	2.310	3.06	3.32
4—Carnegie 1.0 per cent. copper O. H. steel	1.77	2.255	3.02	3.28
5—Ingot iron	1.39	1.880	2.65	2.93
6—Same as No. 3 not filed.	.. .	... .	....	....
7—Same as No. 4 not filed	....	.....	....	....

From results on samples 6 and 7 in pans Nos. 1 to 4, inclusive, it appears that the copper oxidation on the surface, compared with the identical samples Nos. 3 and 4, but with the oxidation removed, protected samples 6 and 7 for 3 months, but the protection appears to have disappeared at the end of 6 months.

Perhaps the most significant figures are those showing the relative corrosion of samples 2, 3 and 4, as they are of the same grade of steel, made by the same manufacturer, and are presumably identical in quality, the difference copper content excepted. In regard to the addition of the copper, we quote from the letter to the manufacturer, as follows:

"In regard to the addition of copper, would say that the heats are made up as far as possible with copper scrap and any deficiency in the copper content is made up by adding the requisite amount of metallic copper to the bath in the open-hearth furnace, about 15 minutes or ½ an hour before tapping. The copper, therefore, has ample opportunity to become evenly distributed in the steel, particularly by the mixing action which take place when the steel runs from the furnace into the ladle."

It will be observed that the corrosion of the ingot iron is substantially the same as the other samples, except in pan No. 5. containing the overflow water. Of this water, Mr Stuart W. French, General Manager Copper Queen Consolidated Mining Company, says: "We have found that the water is extremely corrosive in our water jackets up to a temperature of say 150° F. Above that temperature it seems to have little action. It is good water for our boilers, but in pipes and water jackets, where the water is cool, pitting action is very strong."

The steel water jackets of the furnaces mentioned require frequent renewal on account of corrosion, and it was for this reason that it was selected as one of the corrosive mediums. The corrosive action of this water appears somewhat similar to that of an acid, and it will be observed that, while the corrosion of the ingot iron in the other corrosive mediums is not materially different from the other samples, it shows considerably less corrosion in the water, which conforms with its known ability to resist sulphuric-acid test.

The corrosion of all samples in the clean sand is greater than in the clay and alkali soils. Rather the reverse would be expected, especially in the alkali soil. This may be particularly due to the fact that the sand is porous and allows a comparatively free circulation of air, while the clay and alkali soils are cross grained and practically exclude the air.

Effect of Regulation.

Delos F. Wilcox, consulting franchise and public utility expert of New York city, in an article in "The Annals of the American Academy of Political and Social Science," discusses the effects of state regulation upon the municipal ownership movement. Mr. Wilcox says in part:

"When the policy of state regulation was launched 7 years ago, it received the cordial support of three classes of citizens: (1) Those who were utterly opposed to municipal ownership, but who recognized either the necessity or the inevitableness of stringent public control; (2) those who were uncertain about municipal ownership and deemed it expedient to try the experiment of regulation, with the hope that it might succeed and thus make public ownership unnecessary; and (3) those who were definitely convinced that municipal ownership was desirable or necessary as an ultimate policy, but believed that regulation would be a good thing as a stop gap while public opinion and public administration were getting ready for the inevitable. Influenced by these various hopes and expectations, the supporters of the new policy formed a somewhat motley political group. They included not all, but the major portion of, the progressive citizens of the country who desired to redeem the state and local governments from the domination of public service corporations.

"At first the opposition to state regulation was made up primarily of three elements, viz: (1) The public service corporations, which were naturally hostile to a movement promising more minute and more rigid public control of their activities, and which, much as they disliked the interference of local governments and state legislatures, had by long practice learned how to meet these interferences and, therefore, preferred to keep on fighting in the old way rather than to face an new enemy and have to learn new tactics; (2) the corrupt and semi-corrupt political leaders and organizations which had acquired and maintained their power largely through their alliances with public service corporations under the old system of 'give and take;' and (3) a comparatively small number of uncompromising municipal ownership men and municipal home rule advocates, together with a number of city politicians who had made political capital out of old feuds with the public service corporations. This third element of opposition manifested itself in spots where, through long local agitation, cities thought they were getting near the municipal ownership goal, or at least were getting into a position where they could, through franchise contracts and local regulation, secure better conditions as to rates and service, and where they feared that the sudden transfer of all powers of control to a State commission, subject to the domination of State politics, would constitute a serious setback locally.

"Largely as a result of the attitude assumed by the regulating authorities, the line-up of forces on the political issue involved in state regulation of public utilities has considerably changed from what it was 7 years ago. The public service corporations themselves, instead of being unanimously hostile to state regulation, as they were in 1907, have veered about until they appear to furnish the chief motive power behind the movement in those communities where state regulation has not yet been fully established. Doubtless the corporations have been and still are greatly annoyed by some of the positive or negative requirements of state commissions, and doubtless some corporations would gladly go back to the old system of haphazard regulation rather than submit to the systematic regulatory procedure now in vogue. Nevertheless, most corporations have come to see advantages in regulation itself, and very great advantages in state as opposed to local regulation. By means of State regulation, they escape from the annoyance of local nagging and the immediate political pressure for lower rates, and appear to feel that they are stealing a march on the municipal ownership forces by a short-cut across country. They expect to get so far out of sight of the municipal ownership movement that they hope never to see it again, or be seen by it.

"On the other hand, it is fairly certain that the general public has been as unhappily disappointed in the general results of state regulation as the companies themselves have been happily disappointed. As in the case of corporations, the extent and nature of this disappointment are not uniform, either in time or place. Some commissions, as notably the Railroad Commission of California (which, however, does not have uniform jurisdiction over strictly local utilities), have borne down upon the corporations with a pretty firm hand, and have thereby maintained their prestige with the people, while at the same time they have disarmed the opposition of the companies by the fairness of their severity. Generally speaking, however, the popular prestige of public service commissions is wanting. The people are disappointed in the results obtained for the money spent, and a great many are coming to fear that the commissions, as organs of government, are primarily organs of the public utility interests to protect themselves from the mosquito bites of rampant democracy. At the same time there is a noticeable revival in the movement for municipal ownership and a strengthening of local resistance to the practical abrogation of municipal home rule as it relates to public utilities.

"The Wisconsin law and Wisconsin commission probably typify the state regulation movement, as it exists in practice, better than those of any other State. In certain respects the Wisconsin law is still in advance of most of the other commission laws. This is practically true with reference to the indeterminate franchise which has been made to apply by legislative mandate to all of the public utilities operating in Wisconsin. This law, while not depriving the municipalities of the right to withold their consent to the operation of public utilities in their midst, makes every franchise heretofore or hereafter granted a perpetual franchise, subject to termination on one condition only, viz., that the municipality shall purchase the plant of the utility at a valuation to be fixed by the state commission.

"Under this law, the legal right of the municipalities to embark upon the policy of municipal ownership of local public utilities has been made universal, but the cities have been deprived of any right to build competing public utilities without the consent of the state commission, or to acquire existing utilities by negotiations or under the terms of franchise contracts. For example, it would appear that no city in Wisconsin now has the authority to grant a franchise under which the utility would be required to withdraw its capital out of earnings and transfer its property to the city at some future time without payment. No method of bringing about municipal ownership is contemplated, except the single method of paying for the property a sum equal to its value at the time of its transfer to the state commission.

"Under these conditions about a dozen public utilities have been acquired by municipalities in Wisconsin during the past seven years, but for the most part these utilities are in small towns and represent a comparatively small investment. No street railways have as yet been taken over in Wisconsin under this law. It is too early to predict with certainty just what practical effect the Wisconsin indeterminate franchise plan will have upon the municipal ownership movement, but it is clear that it provides an inflexible procedure with no opportunity for adjustment to the varying conditions of different localities, and that a city cannot proceed to municipal ownership without submitting to the judgment of the state commission in fixing the price to be paid for the property, and the terms and conditions of the purchase, subject to appeal by either party to the courts. Moreover, without the consent of the state commission, no city can build a plant of its own in competition with an existing private plant.

"In California, where the right of municipal ownership and operation has been established by constitutional provision, and where the control of local utilities remains for the most part in the hands of the local authorities, the state commission, nevertheless, has it within its power to hinder and possibly to prevent municipal ownership in particular cases by refusing its consent to the sale of a public utility to a city on the terms agreed upon between the parties.

"In New York and New Jersey, franchises granted by local authorities require the approval of the state commissions, and in New Jersey, when such franchises are approved, the state commission may impose its own conditions as to construction, equipment, maintenance or operation.

"These illustrations show the tendency of the more radical state commission laws to check the freedom of municipalities to advance toward municipal ownership in their own way. Some of the commission laws bring municipal undertakings under the control of the state commission practically to the same extent as private undertakings, and while such regulation is not necessarily inimical to municipal ownership, it may, in some instances, make cities feel uncomfortably dependent upon the will of a state commission, which may be hostile politically or otherwise to the cities' aims.

"This restriction and definition of the methods by which municipal ownership may be attained, and even the supervision of municipal undertakings by the state commissions, may in practice help rather than hinder the municipal ownership movement. But whether they help or hinder, it certainly cannot be claimed that the movement will be unaffected by them.

"The indirect effects of state regulation upon the municipal ownership movement are even more numerous and important than the direct effects.

"It is possible that state regulation, through its failures, may result in greatly strengthening the demand for municipal ownership at the same time that it puts new obstacles in its way. If this proves to be true, we shall have a repetition of the many lamentable experiences of the past in American cities where it has often been found that the people, though in favor of a particular policy by a great majority, are helpless to put it into effect, with the result that political discontent, cynicism and civic paralysis ensue. Perhaps one of the most likely effects of state regulation will be to enlarge the ambitions of the state itself and to create a strong movement in favor of state ownership of the inter municipal utilities, such as interurban railways, water power development and transmission lines. In several respects, a movement for state ownership of utilities not strictly local in their character, would not be handicapped by the tendencies of State regulations to the same extent that the movement for municipal ownership of even stricily local utilities might be so handicapped."

A HEARING has been ordered for Sept. 11 on the petition of the Lynn (Mass.) Gas and Electric Co. and New England Telephone Company for pole locations on Lexington and Goodridge streets, Beacon, Hill and Clarendon avenues.

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NOTICE TO ADVERTISERS.

New Advertisements and changes of copy therefor should be in hand Wednesday noon of week prior to date of issue.

NEW YORK, MONDAY, SEPTEMBER 7, 1914.

[Official Notice.]

Pacific Coast Gas Association, Twenty-Second Annual Convention.

Pacific Coast Gas Association,
Office of the Secretary,
August 22d, 1914.

To the members of the Pacific Coast Gas Association: I take pleasure in advising you of the following arrangement in connection with the 22d Annual Convention of the Association, which will convene at Long Beach, Cal., September 15th, 1914, presided over by Mr. Champ S. Vance, of Los Angeles, Cal.

The address of welcome to the Association will be delivered by Hon. L. N. Whealton, Mayor of the City of Long Beach, and Mr. P. E. Hatch, President of the Long Beach Consolidated Gas Company, will welcome the members on behalf of that company.

Programme.

President's Address, by Champ S. Vance.
1. General Utilization of Gas, by Gas Exhibit Committee.

a. Gas Street Lighting, by C. B. Babcock.
b. Gas Lighting in the Home, by R. J. Thompson.
c. Domestic Use of Gas, by B. S. Pedersen.
d. Industrial Uses for Gas, by H. P. Pitts.
e. Water Heating by Gas, by H. R. Basford.

2. The Nature and Extent of the Obligations of a Gas Company to Improve its Facilities and Extend its Service, by C. P. Cutten.
3. The Appliance End of the Gas Business, by P. C. Wickersham.
4. Welding in Gas Distribution, by D. E. Keppelmann.
5. Wholesale Distribution and Measurement of Gas, by John D. Hackstaff.
6. Problem of Pressure Reduction and Regulation, by A. W. Cash.
7. "Safety First," by C. A. Luckenbach.
8. Gas versus Electricity for Cooking, by R. C. Powell.
9. Wrinkles, by H. W. Burkhart.
10. Experiences, by John Clements.

It is sincerely hoped by the officers of the Association that the members will avail themselves of the many courtesies which will be extended to us by the Hotel Virginia, in order to show our appreciation of the efforts put forth by the management for our entertainment.

The papers which have been prepared for the meeting surpass all previous efforts and contain the last word on the subjects concerned.

The Gas Exhibit Committee, in addition to the excellent papers which have been prepared by them, have arranged for an up-to-the-minute exhibition of appliances, which will be open to the public.

The officers of the Association have left no stone unturned toward making our 22d Convention the usual success, and the appreciation of the members of this fact can be demonstrated in no more fitting way than by their arranging to be in attendance.

Henry Bostwick, Secretary.

[Special Editorial Correspondence.]

TWENTY-THIRD ANNUAL MEETING, MICHIGAN GAS ASSOCIATION.

Lake Harbor, Mich., Sept. 2, 1914.

Yesterday's trip was unpleasantly warm, but a heavy rain last night and a cool breeze from the lake makes this morning like September. This is a beautiful place for an outing and a good hotel adds to the attraction, but the time chosen and business conditions seem to have prevented as large an attendance as usual at Michigan meetings. About 50 had assembled at 10 o'clock this morning, when President Douglas, flanked by Secretary Chamberlain and Stenographer Gurtley called the twenty-third annual meeting to order. The roll call and reading of last year's minutes was passed up, and the reports of the executive committee, secretary and treasurer were read, after which the President spoke briefly of conditions in Michigan and in the association from its founding in 1891 with 11 members to its present 300, and its endeavor to make closer relations of the companies to the public, their employees and stockholders. The value of the educational courses of the two national associations and the courses at the University of Michigan on gas engineering and the association's scholarship work, affiliation with the Institute is at present outlined most attractively. Work of State associations should be on lines of local policy and management leaving larger problems to national associations.

Mr. Shacklett's paper, "Would Michigan gas plants benefit by service of an Efficiency Engineer" inclined to extend authority and interference by commissions in operation; discussed by Messrs. Dewey, Davis, Wright, President Douglas, Snyder, Bigelow, Graves. Motion passed for committee to take up mutual liability insurance and co-operative benefits. Next followed Mr. J. T. Young's paper, "The Increased Cost of Gas." Characterized by President as paper that should be published in every newspaper in State; discussed by Messrs. Graves, Whelan, Batten, Snyder, Aldrich, Fowler. Paper on "Detroit's Coke Campaign," read by Mr. V. F. Dewey. A description of what has been accomplished by co-operation with coal dealers. Discussed by Messrs. Young, Dewey, Douglas, Davis, Hastings. Adjourned at noon until to-morrow morning. Afternoon will be devoted to sports. Bohemian banquet to-night. To-morrow afternoon bowling contests. Miss many of the old faces.—Camp.

Thursday, September 3, 1914.

This morning's session was opened about 10 o'clock, with report of Committee on Nominations, naming for President John T. Young, of Grand Rapids; Vice-President, Burton R. Laraway, of Jackson; Secretary and Treasurer, Glenn R. Chamberlain, of Grand Rapids. Committee on Time and Place of next meeting recommended leaving decision to the Executive Committee.

Address by Mr. H. N. Tolles on "Confidence" was a wonderful business talk. "Electrical Separation of Tar from Coal Gas," read by R. B. Rowley, who was the holder of the Association Scholarship of Research at University of Michigan and is at plant of Ann Arbor Gas Company. Very interesting paper discussed by Messrs. Batten, Seymour, Snyder, Blackwell. Report of Scholarship Committee by Chairman Batten. This year's work covered the weathering of coal and electrical separation of tar. Next year will continue weathering of coal and the proposed matter of the commercial utilization of gas, and also hope to enlarge the scope of the Gas Engineering Course at the University.

Mr. H. C. Blackwell, as representative for the American Gas Institute, spoke of recommendations of Mr. W. H. Gartley, the President, for closer relations between the State and National Associations in technical matters and public relations. Voted for a committee to confer with other district associations and Institute to consider affiliation. Letter from Mr. A. P. Ewing, representative on Joint Committee of Gas Congress, asking authority for contribution of $25 to funds voted. After some closing remarks by President Young, the Convention adjourned. Few leave to-day; many remain to finish sports. President Douglas a good presiding officer.

Attendance increased hourly, so that when time for banquet arrived fully 80 were there. "Bill" Guitteau was general manager and "Al" Eaton, toastmaster. Could you beat that combination? When we started the second course Eaton started the speakers. President Douglas, Dewey, Russell, Dickey and Bigelow, offered a rising toast to the memory of our departed friend, "Tom" Cunningham. S. K. Campbell, editor of the Journal, spoke briefly in response. Then followed stories from Eaton, Davis, Harbison, Whelen, Moran, Tolles, Guitteau. At 9:20 we left the dining-room, and many spent an hour or more on the shore of Lake Michigan watching the high surf, all beautifully illuminated by a moon nearly full.—Camp.

BRIEFLY TOLD.

IMPORTANT CASE DECIDED.—A case involving the rates of seven gas companies furnishing natural gas to the people of ten of the northern counties of West Virginia, and which at the same time placed in the balance the jurisdiction of the State Public Service Commission over rate regulation of gas companies having pipe lines running into other States, has been decided in favor of the commission on almost every point. It was heard by a joint court, consisting of United States Circuit Judges Pritchard and Woods, and United States District Judge Dayton.

About a year ago the Manufacturers' Light and Heat Company, a holding and operating concern for the seven companies, filed a petition with the public service commission asking permission to increase rates. The commission held a number of hearings and in deciding the case not only refused an increase, but entered an order establishing a new schedule of rates, which provided for reductions of from 1 to 7 cents a thousand feet.

The order was made effective May 1, but before that date the company appealed to the United States Court for the northern district of the State and got a temporary injunction which restrained the commission from making its order effective until the case should be decided by a joint court. This came up for hearing June 6, at which time the matter was taken under advisement by the court, and its decision was announced Juiy 29. The company had set up as its plea that the commission had no right to go into the case further than a decision on whether or not the increase asked was justifiable and that it could not, on its own volition, order reductions unless such reductions had been petitioned for. It further contended that the commission had no right to hear the case since the company which owned and managed the seven companies in West Virginia also operated wells in Ohio and Pennsylvania, the gas of all of which flowed and comingled in the same pipe lines, making it a matter of interstate regulation.

The court upheld the contention of the commission that it has the right and power to take up rate or service cases either on petition or on its own volition, and further that even if the service of the operating company should be considered interstate business, the United States Congress never has acted on it and it therefore is left for State regulation.

The company also contended that the schedule of rates established by the commission, if put into effect, would be confiscatory. The court upheld the opinion of Commissioner Howard N. Ogden, who prepared the material matter in the State's briefs, that according to the evidence presented to the commission the rates established were just. The company had contended that in making rates for a part of its system justice would require consideration of the cost of production throughout the system in West Virginia, Ohio and Pennsylvania. On this point the court held that it could not presume that regulating bodies in Ohio and Pennsylvania would not take into consideration in regulating rates there the increased cost of production in those States over that in this State. It declared that as the commission of West Virginia could not justify unusually low rates for consumers here on the ground that low rates were charged in interstate business, neither could the company justify higher rates to West Virginia consumers on the ground that such rates were necessary to make lower rate charges in interstate business profitable.

MONTANA COMMISSION ON DEPRECIATION.—In the Helena Light and Railway Company case, recently decided, the Montana Commission discusses the question of depreciation as applied to valuation for rate making as follows:

"Whether or not the valuation thus obtained is subject to depreciation, and if so, to what extent, is a matter of expert opinion, depending upon the amount expended for maintenance, renewals, and permanent improvement work; the period during which such amounts were expended, and in general, the 'state of repair' of the property. It will be obvious that there can be no fixed percentage of depreciation applicable to a utility that has been 'kept up' from year to year by constant effort, and the purchase of improved devices, as compared with one that had been allowed to deteriorate through neglect; hence the principle of an arbitrarily established measure of depreciation is untenable.

"Assuming that rates were being made for a new plant, it would be the total capital that must be considered as entitled to bear interest, as there would be no accrued depreciation. Depreciation is a liability against the property, which must be accounted for. Let us assume that an investment is made in 1903 of $100,000, under a 20-year franchise; rate of interest allowable 10 per cent. per annum; and figuring 5 per cent. per annum depreciation. At the end of ten years, or in 1913, the property will have depreciated $50,000 and has a remaining value of a like amount. Then, if rates are made, based on depreciated value, they must be one-half of the original rates, although the service may be just as efficient as it ever was, and in 10 years more, the physical value of the plant would be nil, and likewise, upon the same basis of reasoning, the utility would not be permitted to charge anything.

"The Commission cannot determine the present question upon a physical or other valuation of the entire holdings of respondent, for the reason that no valuation has been made, except for the electrical department. We must, therefore, confine ourselves to what would constitute reasonable rates for the service rendered, in view of the evidence submitted and that secured by the Commission's investigations. Valuation of tangible property devoted to the cause at issue is a factor in an investigation of this nature, but the Commission is not convinced that it is the sole factor for the purpose of rate-making.

"There are other things to be considered as well. The relation of one department to the other; the company's obligation to the public, and its security holders; the present physical condition of the property; the quality of the service; its unit of management, and the value of its rights and privileges under the terms of its franchise, and in this particular case, the fact that the defendant must pay to the city a cash bonus of approximately $5,800 a year, all are matters that must be dealt with."

CITIES SERVICE COMPANY'S LETTER.—The Cities Service Company decided, in view of the present unsettled condition of the money market, to issue from time to time a letter to its stockholders, keeping them definitely in touch with events. We quote from the second letter, sent out by President H. L. Doherty: "Your directors adjourned the meeting planned Friday, Aug. 7, until Aug. 10, to secure the presence and advice of Messrs. Mitchell and Brown, who were passengers on the *Mauretania*, from England. At the meeting the general financial and business situation and the probable outcome were carefully considered. The situation to-day can be summed up by the statement that practically every stock and commodity exchange in the world is closed, a moratorium has been declared in Great Britain and France until the end of August, and a moratorium in effect exists in every financial center in the world. It was the opinion of all that events subsequent to the last meeting of the board of directors fully justified the wisdom of their action in deferring the payment of cash dividends for the present. It is still practically impossible to transfer money from one country to another for the payment of dividends or for any other purpose. Your directors, therefore, decided to postpone further action until developments enable an accurate forecast to be made, and instructed the executive committee to keep in close touch with the general situation and the affairs of the company, and to prepare to make definite recommendation to the board at the earliest opportunity. Many of our stockholders were not in close touch with the financial situation at the time your directors decided to defer the payment of cash dividends, and are only now awakening to the severity of the disturbance, and may be led to believe that the situation is growing worse instead of better. Your directors are of the opinion the situation is improving daily, and much credit is due to the administration in providing governmental aid by the prompt supply of emergency currency. Our managers generally report that business continues to be good, but that some difficulty is being experienced in making collections from large customers. Of course it is impossible to predict accurately the effect upon collections and earnings, but your directors see no reason to be alarmed over the probability of the earnings of the subsidiary companies being seriously affected—in fact, they feel that recent developments are favorable rather than otherwise. While your directors deeply deplore the results which are bound to be experienced from the present situation, they feel that the holders of public utility securities have every reason to feel that they have been fortunate in their choice of investment, and especially in their holdings of stocks in companies, such as Cities Service Company, which represents a wide diversity of lines of effort in widely scattered communities from seaboard to interior cities principally dependent upon agriculture. The stockholders of the company may feel sure that everything will be done to protect and promote their interests, and that the management is in touch with every turn that the general situation may take. We have been at all times in exceptionally close touch with the European situation, and, while it is no longer possible to communicate by cable using private codes, we will be as close to the developments there as anybody can be.

"While we may have seemed to be the first to be alarmed over the situation, we think that this was due to our closer and more intimate contact with events. What seemed such bad news to many people during the last week or 10 days is rather encouraging to us than otherwise; and, bad as the present situation may seem, it is, on the whole, vastly improved—and we believe that we can predict that recent developments insure further improvement."

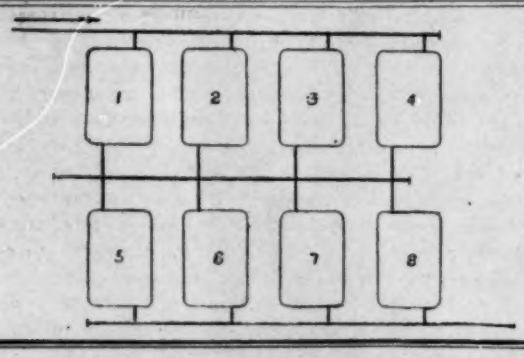
A New Arrangement of Purifying Boxes.

Mr. Guillet, in a paper presented to the Société Technique, describes an arrangement of purifiers in two stages.

He has found that in works using three successive boxes that any impurity left after the second box was not appreciably removed in the third. This phenomenon had occurred in his practice so often that he was led to think that where the cyanide constituents of the gas were not removed by washing, if purification was not completed by the second stage it was very often impossible to entirely remove the sulphuretted hydrogen. He believed that this fact could be explained by the existence of a certain proportion between the hydrocyanic acid and the sulphuretted hydrogen in the gas, under which the H_2S did not act upon the oxide. The hydrocyanic acid acted like a strong mineral acid, decomposing sulphide of iron and liberating sulphuretted hydrogen. There was thus nothing paradoxical in the existence in a gas of sulphuretted hydrogen without action upon oxide of iron exposed to it. On the other hand, the absorption of hydrocyanic acid by peroxide of iron takes place actively only in presence of oxide of salts of iron in the ferrous state.

When shavings are added to the material in the purifiers their color becomes bluer (more charged with cyanide) than the active material. The cause is probably some reduction of the iron peroxide to the ferrous state, with consequent absorption of hydrocyanic acid. This explains why a gas containing a little ammonia is purified more readily than one which has been thoroughly washed. The particular proportion of sulphuretted hydrogen to hydrocyanic acid is not regularly maintained, since the two impurities are absorbed at different rates. Those who add about 2 per cent. of air in the purifiers notice that while the material, during the first stage, is black, it is greyish white in the second stage, showing the presence of ferrous cyanide, which on prolonged exposure to air becomes deep blue. The sulphur is taken up almost completely in the first stage, and a greater or less proportion of hydrocyanic acid in the second. Where hydrocyanic acid is removed by the wet method—for example. by washing with ferrous sulphate and ammonia—no anomalies are observed. If purification was not complete at the second stage, it did ultimately become complete. It was not a case of equilibrium, as in the method already referred to. The washing removes practically all of the hydrocyanic acid.

These considerations led him to conclude that if hydrocyanic acid is not removed by the wet method it is a mistake to employ three successive sets of purifiers. The boxes and the material are much better utilized by arranging them in two groups; the surface offered to the gas being thus proportionately increased. An arrangement of purifiers on these lines is shown in the cut.



The first and second stages are similar, each having 4 boxes in parallel, and each box 12.5 square metres (134.4 square feet), or 50 square metres (538 square feet) for each of the stages. Each purifier of the first stage delivers gas into the box of the second stage corresponding with it; but the connections are joined together to equalize the pressure. The gas is freed from hydrocyanic acid by washing with ferrous sulphate, and about 2 per cent. of air is added to it by a pump. The purifying material used is an oxide made by chemical precipitation, used without shavings or sawdust, and in layers about 24 inches deep. Assuming all the purifiers charged with fresh oxide, it will be found at the end of 2 or 3 months that box No. 1 allows foul gas to pass, most of it going through No. 5, in which purification is completed. It is the gas from the outlet of box 5 which is thenceforth tested, ignoring that from No. 1. As soon as the gas from No. 5 shows a trace of impurity, No 1 is cut out and the contents removed. Working this way there is no practical danger of exceeding the limit of impurity, since the gas at the outlet of No. 5 is only ¼ of the total production.

On opening No. 1, a top layer of greater or less thickness, and generally very dry and powdery, is found to consist of red oxide, almost unaltered; this is thrown out by itself. Below this layer is another, black and hard, requiring a pick to break it. On testing, it is found to contain from 50 to 55 per cent. sulphur, and is added to the stock of spent oxide. The purifier is then recharged, first with the powdery oxide, and then with fresh oxide, and put into use again. This series of operations is repeated with each pair of purifiers, as opportunity offers, in order to ensure constant production of clean gas. A fact to be noted is that No. 5, which had begun to sulphurize at the end of the first phase, automatically renews itself when No. 1 is again put in use, and delivers gas completely free from sulphur, but still containing a very slight excess of oxygen. The boxes of the second stage are always damp and almost without any trace of sulphuration. M. Guillet records the instance of one which remained in use 400 days without being opened, and when examined, out of curiosity, was found to be in perfect condition. These purifiers, receiving only gas which has been almost completely purified, need not be opened for years.

If, however, the hydrocyanic acid is not first removed, it is not possible to carry out the system. The sequence of changes would be the same as described up to the renewal of box No. 1. But following this renewal, the gas entering No. 5 would liberate the sulphur previously absorbed, owing to its content of hydrocyanic acid; and the gas at the outlet of No. 5 would be open to suspicion at the time of the renewal of No. 1, and would become positively sulphided as soon as it was again in operation. To avoid this, it would be necessary to open No. 1 as soon as the gas passing it showed a suspicion of impurity. Then the second stage would not proceed normally; it would only be a measure of security intended to guard against anything unforeseen.

The advantages claimed for the system, are as follows:

1. No material is exposed for revivification; and no buildings are necessary beyond those required for the storage of the fresh and spent oxide.

2. The purifiers are always at their maximum power, since they are always charged with fresh material and all are working.

3. Economy of labor; the material from its being charged fresh into the purifiers to its removal when saturated being handled only once.

Some experiment is necessary to determine the proportion of air suitable. With too little air the reaction is not sufficiently energetic and the material remains powdery, and does not become so rich in sulphur that it can be treated after using. The purifiers of the first series are always considerably above the outside temperature. This is an indication of good working. If it is feared that the material will fire on removing the cover, the purifier can be thrown out of action for 24 hours before opening; the contents cooling down. When the temperature is low, the reaction is less energetic, and it may be of advantage to heat the gas in order to bring about satisfactory caking of the material. The latter will not cause back pressure, for the purifiers will register 20 to 30 mm. (8 tenths to 12 tenths); the material drying as it becomes sulphided. Dry oxide in the powdery form is as good as moist oxide. There is no need to dry the material on its removal from the purifier. If the gas enters the purifiers at the top, handling of the unattacked oxide may doubtless be avoided by removing only the hard portion and replacing it by fresh oxide.

As showing the advantage of his system in practice, M. Guillet quotes the results on 35.3 million cubic feet of gas. The figures represent workings in 3 years, in each case at the same time of year; the temperature being chosen as nearly comparable as possible. Each test covered 6 months.

Ordinary purification: One vessel purified 17,425 cubic metres (615,100 cubic feet) of gas.

Using 2 per cent. tar: One vessel purified 75,148 cubic metres (2,653,000 cubic feet) of gas.

Hydrocyanic acid washed out, and with 2 per cent. of air: One vessel purified 142,800 cubic metres (5,000,000 cubic feet) of gas.

The dimensions of the boxes were 3.4 by 2.4 metres (11 feet by 7 feet 9 inches); and the depth of the oxide was 0.6 metre (24 inches), representing a bulk of about 5 cubic metres (177 cubic feet). About 3 cubic metres (106 cubic feet) were treated for recovery of sulphur; the other 2 cubic metres, non-attacked, remaining in use. The conditions throughout the three series were the same, excepting that during the first the oxide was mixed with shavings, and a somewhat deeper layer used.

High Pressure Gas for Street Lighting.

[From a paper by T. SINGTON, Manchester, England, in *Municipal Engineering*.]

High pressure gas illumination for important streets has been extremely successful in London, Paris, Berlin and large towns such as Birmingham; in some cases installations have been less successful, and it may be interesting to draw attention to only partial success, in order that the system, wherever introduced, may always give best results. All the practical advantages claimed for electrical lighting, such as simplicity of switching, possibility of dispensing with lamp lighters, economy of cost and so on, are also obtained with gas high pressure installations.

Complaint of extensive and dangerous leakage of high pressure gas is only made possible by neglect on the part of main-layers, and is easily avoidable. All mains, after being laid, must be subjected to severe tests and any subsidence prevented by bedding the mains where necessary on a foundation of concrete.

No detrimental effect is caused by foggy or heavily smoke-laden atmosphere on the gas mantles, and rays of gas lamps penetrate fog considerably better than those of electric lamps.

The great objection to electric street lighting is the intense glare of the arc lamps. In this respect gas lamps are superior for the eyes, because the source of light is larger than the arc of the electric lamp. There is still ample scope for both gas and electric light engineers to improve the distribution of light. Experiments, if they resulted in nothing else, would also probably lead to improvements tending to lengthen the effective life of the gas mantles, which are at present insufficiently protected from the weather. Some experts assert that all sources of light should be screened down so that their intrinsic brilliancy does not exceed that of the sky, which is estimated at about 3-candle power per square inch.

The measurement of light and illumination has now become a science, the degree of accuracy of which is only limited by the personal error of the observers. Street photometry can measure within 5 per cent. of the direct candle power measurements and within 7 per cent. of the horizontal illumination measuremonts. To determine the illuminating effect of high pressure gas lamps a portable photo meter may be used for rough measurements, fitted with a Bunsen screen; the type known in Europe as the Universal photometer, the accuracy of which is very high as the flicker attachment reduces the error due to color of light source. The illumination of streets by means of light sources fixed at intervals along it, results in varying degrees of illumination, depending upon the distance from the light sources; and as that illumination is proportionate to the square of the distance, and the angle at which the light falls on the surface, it will be seen that much depends not only on the candle power of the lamps, but even more on their spacing along the street and the height at which they are erected. With the object of bringing all these factors into a common factor for comparison, it is becoming the practice to compare the illumination of streets by ascertaining the minimum horizontal illumination at any part of the street on a screen 3 feet above the ground level. This minimum is considered the important factor, as it embodies all others; and because, if the minimum illumination is sufficient for the pedestrian and road traffic, the illumination throughout the remainder of the street must be ample.

To test high pressure gas illumination of streets satisfactorily, a series of tests should be made extending over a period of several weeks, including photometric measurements of candle power and illumination, carried out every consecutive night, weather permitting. Periodic measurements of the gas consumption and gas pressure should be made. Whilst tests are being made the lamps under examination must be operated precisely as in ordinary practice; adjustments and alterations being permitted only when absolutely neccessary.

The following details of tests made on high pressure lamps, will give point to what has been stated. The lights tested are known as the Keith high pressure gas lantern, each containing three inverted mantles supplied with gas raised to a pressure of 55 to 60 inches of water, by a compressor.

The lamps were suspended from span wires, a tower ladder being used to adjust and trim them. The central hanging of light sources has many advantages, where powerful light units are necessary, as in very busy thoroughfares. The most important are that the lamps can be hung high so that they do not come into the line of vision of pedestrians or drivers of vehicles; furthermore, the lighting of the footpaths is much more even than when the light sources are on poles along the edges of the footways. The only serious disadvantage is the inaccessibility of the lamps. With high pressure gas lamps, the lowering gear may cause trouble with the joints It has, therefore, been suggested that the lamps could be supported from brackets attached to the buildings.

The average height of the lamps tested was 26 feet 6 inches and the distance apart 107 feet, or 49 lamps to the mile. Most of the photometric measurements were made at the following angles: For the maximum illumination 45° from the horizontal, and for the minimum 20 to 25° from the horizontal. Measurements extending over several weeks gave the following results: Average candle power at 20 to 25° from the horizontal, 1,750; average at 45° 1,670. Average minimum horizontal illumination derived therefrom on the pavement 0.39-foot candles; average maximum horizontal illumination on the pavement, 1.9-foot candles.

The costs excluding capital charges on lamps and special mains were made up as follows: The cost of low pressure gas delivered to the compressor plus the cost of compressing; mantles and renewable parts; labor charges of lighting, extinguishing and renewing parts. The cost of the gas delivered at the compressor was 25 cents per 1,000; compressing, 4 cents per 1,000; making a total cost of 29 cents per 1,000 cubic feet in the high pressure mains. Careful consumption tests showed that the consumption per mantle was 26.5 cubic feet per hour, or 79.5 cubic feet for each lamp, giving a cost per hour for gas at 2.294 cents per hour. To this must be added the cost of mantles, globes and labor, making the total 3 cents per hour. The capital cost of plant and apparatus, including lamps, lanterns, poles, suspension and all accessories was $240 per lantern, excluding the high pressure gas mains and compressor plant. The capital cost per mile of street would, therefore, be $11,760. During the time the tests were being made the maximum variations of any lamp were from 2,058-candle power to 686 candle power, and for all the lamps tested from 2,475-candle power to 686-candle power. As stated above the gas cost 3 cents per hour, equal to $60 per lamp per annum for 2,000 hours, or $3,240 per mile of street.

High pressure gas street lamps have on occasion been found not to give the full results expected, because not properly installed or adjusted. It is of extreme importance that the correct height should be ascertained. The height given above, 26 feet 6 inches, is too great to yield the best results, giving only 27 candles per foot of gas. Placed at more suitable height the efficiency should be at least 50 candles. Lamps placed at a height of 20 feet with only 2 burners, adjusted to proper efficiency, would give a light equal to, if not better, than the 3 burner lamps discussed. The life of a mantle was found to be 400 hours, therefore, each 3-burner lamp would require 15 mantles per annum. The cost given above for compression is too high because the compressor was not worked to its full load.

Lightning Conductors.[1]

The generally accepted opinion is that lightning discharges are of two distinct kinds, named by Sir Oliver Lodge, "A" and "B" flashes. The "A" flash is a discharge from an electrically charged cloud which is approaching the surface of the earth without any intermediate cloud intervening. Its path is more or less prepared by the electrostatic conditions of the case, and it is said to strike pointed conductors in preference to others.

The "B" flash is a disruptive discharge of great suddenness, and arises where another cloud intervenes between the cloud carrying the primary charge and the earth, the two clouds acting like a condenser. The Lightning Research Committee of 1905 reported that "when a discharge from the upper cloud takes place into the lower cloud the free charge on the earth side of the lower cloud is suddenly relieved, and that the disruptive discharge from this to the earth takes such an erratic course that no series of lightning conductors of the recognized type suffice to protect the building."

Lightning discharges are sometimes quite silent, and may pass unobserved. I remember some overhead electric conductors erected under my supervision in the grounds of a building on very high ground. I had lightning arresters attached to these where they entered the premises. Curiously enough during the first summer, although several severe storms occurred, nothing observable hap-

1. From a paper by Mr. F. H. Taylor, before the Junior Institution of Engineers, London.

pened. During the second summer, however, when everyone agreed that no storms had been noticed, one after another the lightning arresters gave evidence of having received discharges—apparently silent ones.

Lightning is stated by many authorities to act like weak human nature, and to select the path of least resistance, but what forms the path of least resistance—the lightning alone decides.

Protection against "A" flashes is fairly easy, and the ordinary system of conductors, when properly constructed and maintained, is reasonaly safe. Discharges of the "B" type involves more complex treatment, and in the words of the Lightning Research Committee, 1901-5, "absolute protection can only be assured by a complete wire-work enclosure, of the nature of a bird cage." In any case, the extent to which a building shall be protected and the cost of such protection, usually has to bear a certain relation to the importance and the cost of the building. Unfortunately, the lightning conductor work of most buildings is treated with an indifference as dangerous as it is unjustifiable. The specification for a building costing perhaps £10,000 to £12,000 will sometimes dismiss the whole matter by merely stating "allow £10 p.c. value for lightning conductor." With such a detailed description it is not surprising that any sort of job forms that so-called lightning conductor system—often put up by people quite ignorant of the work. It is regrettable that insurance companies have not found it possible to insist upon adequate protection and maintenance. A public building which cost £125,000 came under my care, and on examining and testing the conductors I found them absolutely useless as well as being a definite source of danger.

Briefly put, any lightning conductor system comprises: (1) The air terminal or "elevation rod," the top of which is provided with one, three, four or even five points; (2) the conductor, from the elevation rod to the ground, with branch conductors from other parts of the building, or from the metal work of the structure, such as gutters, stack pipes, metal roofing, etc.; and (3) the earth connection.

The metal most commonly used is copper, in the form of tape from say 1½ inches by ⅛ inch, down to ½ inch by ⅛ inch. Iron is electrically efficient but is more subject to corrosion and not so easily fitted into position. The design of the conductor system can only be settled when the design of the building, including its chimneys, turrets, gables, ridges, roofing material, etc., is known, and some consideration must also be given its general situation. For guidance, a few general principles may be given:

1. Conductors should run in as direct a line to earth as possible. Some persons prefer to keep them a certain distance from the wall. This has the advantages of avoiding an accumulation of dirt and also avoiding sharp bends when crossing over cornices, etc.
2. Vertical rods should preferably be connected by horizontal conductors fixed to ridges or other suitable part.
3. Roof metal work, etc., should be connected to the system.
4. Chimneys should be protected as being specially liable to be struck, owing, of course, to the column of hot gases which are good conductors, the carbon lining to the chimney in the form of soot and the mass of metal work at the base, in the form of a stove.
5. Joints in conductors should be both soldered and screwed together.
6. Conductors should be kept as much away from interior gas pipes or electric conduits, etc., as possible.
7. Similar metals should be used throughout, *i. e.*, the holdfasts should be of gunmetal, and screws or rivets, etc., of copper.
8. Long runs along ridges, etc., should preferably have more than one elevation rod, at least one at each end, several short points along a ridge being better than a few tall ones.

The earth connection is of utmost importance, and if it be inefficient the whole system may be regarded more as a danger than a protection. It is mainly a question of good surface contact between the conductor and moist earth. Merely taking the conductor into moist earth, or even into water, does not necessarily form a good earth connection unless there is a considerable area of contact. The usual method of forming an earth connection is by a copper plate. The thickness is not important provided it is sufficient to withstand oxidization. A plate 30 by 30 inches by ⅛ inch would be more efficacious that one 12 by 12 inches by ½ inch, although the latter contains 72 cubic inches of copper as against 50 cu. inches of the former. The conductor should be well connected to the plate, preferably riveted as well as soldered, and the soldered joint pointed over to retard electrolytic action. Many people bury the plate horizontally, personally I always make the interment vertically. The earth connection should always be kept well away from the building and also well away from gas mains, and it is absolutely necessary that the earth connection should be kept fairly moist so as to have the resistance moderate.

It is usual to bury some coke or cinders with the plate, with a view to retaining moisture. If such material is used it must be thoroughly washed to get rid of sulphur, which would destroy the copper. There are also cases where to bury a copper plate in the ground is to invite certain failure. In the neighborhood of tar or creosoting works, etc., the soil is saturated with ammonia, which is destructive to copper.

To facilitate discharge into the general mass of earth saw-tooth points to the plate are sometimes used. A special type of earthing plate has the following specification: "To be of copper 1/16 S.W.G. tape riveted and soldered the full length of the plate, joints washed of acid and protected by thick coat of tar. Each plate to have four rows of triangular tougues formed out of the plate itself—2 rows of 6 and 3 inner rows of 5 each so that tips of tongues in adjacent rows point in opposite direction, each tongue 3 inches long and tapering from 2 inches to a point. Tongues to be bent at right angles and to point upward when the earth-plates are laid in position." Loose earth or wood charcoal to be filled in and well rammed on top of plate.

The difficulty of keeping the earth connection moist is in some cases a very real one—of course if a pond, lake or river can be utilized it is excellent, provided the plate is kept free from mechanical injury. A patent tubular earth consists of three parts; the upper for connecting to the copper tape or cable, and also to a rain-water pipe; the lower end, which forms the actual earth with a steel spike for driving into the soil, and a removal cap for marking the position of the earth in the ground.

It not infrequently happens that the earth-plate originally installed has failed, and that another cannot be sunk. In this case a live water main makes an excellent lasting earth contact, if the connection between the tape and the pipe is properly made.

The inspection and testing of lightning conductors is conspicuous by its absence, and this is undoubtedly why accidents from lightning are often reported to buildings that have been believed to be protected by conductors. The reasons calling for regular inspection and test are obvious. The air terminals are the most exposed part of the structure and acted on by wind and weather, and in towns, by corrosive impurities in the air, they cannot be made unduly large without being unsightly; very acute bends in the tape are often most wrongly insisted upon, for the sake of appearance; decay of the earth-plate may arise when least suspected, and particularly disconnection just above the ground line.

The tests made should show the conductor to be continuous from air to earth, and to possess a lowness of resistence to earth.

Methods of testing are two: (a) The bell test, which merely shows continuity or otherwise; (b) measurement of resistance test. The first method is of little or no use except as a preliminary. The measurement of resistance is generally made by some form of Wheatstone bridge, the most usual, perhaps, being an ordinary P.O. bridge, worked with a few dry cells, but the prevalence of earth currents, due to telephone and other circuits, has, within my experience, made this type of apparatus very troublesome. A modification of this apparatus is the "Magneto-inductor Bridge," the hand generator providing alternating current which overcomes the difficulty experienced with the ordinary P.O. bridge and battery.

Another method I have used in congested districts is to pass a good current (measured) through the conductor and earth, observing the drop in volts and calculate the resistance from the known quantities. For this purpose I have used a 4-volt accumulator, giving a discharge up to say 60 to 70 amperes.

Natural Gas Investigations.

On the subject of increased interest in recent years in natural gas investigations, Prof. K. Kharitchkoff, in an article translated from the publication, "Neftannoie Dielo," is quoted as saying:

"New inventions in the domain of chemistry have led to the investigation of natural gases, especially in view of the gradual discovery of their components, which were not hitherto known, as can easily be seen by comparing the results of analyses carried out formerly and recently. In the former, all the inert and incombustible residue left was identified as nitrogen, but recent analyses show the presence in this inert residue of such valuable components as belium.

"New light in this respect has been thrown on the matter by the

recent investigations of Tcheko, which have finally established the presence of helium in such gas. This discovery in its turn again leads to the idea of gases as well as of petroleum being of recent origin. But besides the inert residue there is another component part of natural gases which has until now attracted but little attention, but the investigation of which has great practical importance, viz., the presence of vaporous admixtures or gasoline. The study and even the simple statement of their presence in gas is of great importance, as they represent an aid to decide a very important question connected with the outbreaks of gas and petroleum, viz., if, when boring a well, this will prove a dry one or a petroliferous one. There also must be mentioned here the very great technical importance of the question of the presence or absence of gasoline and the possibility of separating it by means of condensation. Owing to this important discovery being ignored, a great error has been made in connection with the Stavropol gas deposits by a Moscow specialist. In subsequent investigations of natural gas carried out in Austria, indications have already been found as regards its easily combustible components, but even then there is no unanimity on the question. Some experimentators carry out the condensation of gasoline before the absorption of the non-saturated hydrocarbons, while others do it afterwards. Such manipulations should be made uniform, and should take into consideration the presence in gasoline of non-saturated hydrocarbons, and the possibility of finding therein various individual hydrocarbons of this series. It would, therefore, be of more practical use to first separate the gasoline by means of Tiftrunk's apparatus, which is used for the condensation of benzine from illuminating gas, then determine the non-saturated hydrocarbons first with fuming and then ordinary sulphuric acid, that is to say, first gaseous ethylene and higher homologues of it, and then, when investigating the unabsorbed part of the gas (paraffin), together with ethane and methane, to also determine during the first stage the non-condensed propane, butane and pentane, which operation could be conveniently carried out by means of my method used in the investigation of blue gas. After separating the absorbed components, there is obtained an inert and incombustible residue, the investigation of which forms the most difficult part of the problem, and here it is necessary to apply the spectrum and general methods used in the investigation of the rare gases."

War Will Not Affect Panama-Pacific Exposition.

We have received advices to the effect that the war in Europe will not cause a postponement of the Panama-Pacific International Exposition. President C. C. Moore states that at no time had the directors a thought of postponing the opening date. According to Lieut. G. W. Danforth, chief of machinery exhibits, the conditions now existing are that 44 states of the Union have made appropriations and are actively engaged in building state pavilions and preparing their exhibits. The various state appropriations are made for a stated period and a delay in the Exposition would necessitate going to the Legislatures for more money. The exhibit palaces are completed, the installations are already begun on a large scale, and it is the desire of the exhibitors to proceed with the arrangements as they have planned.

Thirty-four foreign nations have made appropriations and are actively engaged in erecting their official buildings and preparing their exhibits regardless of war, so that any postponement in the Exposition would complicate the situation. There is nothing in the present situation that seems likely to affect the plans or success of the Exposition. Of the 34 foreign nations, only 3 are concerned in war, and none has yet indicated that its arrangements for participation will be interrupted. France and Italy have cabled that their preparations to participate are proceeding despite the war. The possibile loss of exhibits from countries involved in war will be replaced by increase in other directions. The effect on the attendance will be favorable, for whatever is lost from Europe will be ten times compensated by Americans and South Americans, coming here instead of going to Europe. The Argentine government cabled Aug. 13, that it was preparing to increase its exhibits and accordingly requested the Exposition officials to assign additional space to it. Brazil also cabled that it intended to proceed with larger plans for an exhibit at this Exposition. For the first time in its history China has made application to display machinery, and space has been assigned to the Chinese Republic in Machinery Palace, in addition to assignments in the other exhibit palaces.

Extracting Products from Gas Liquor.[1]

A patent has been taken out by MM. Louis Charles Bonneau and Victor Emilie Hasenfratz for a process for the extraction of the products contained in gas liquor, and the following is an abstract translation of the specification:

In the processes hitherto employed, sulphur or prussian blue has been exclusively extracted; no industrial method having made it possible to extract simultaneously all the useful elements in the raw material. The method which is the object of the invention comprises four successive operations, which, owing to the choice of solvents, the efficacy of the reactions employed for the separations, and, finally, the order adopted to introduce the reagents, make it possible to reduce to a minimum waste in each operation, and practically extract nearly all the materials in the liquor. The operations follow each other as follows: (1) Desication of the liquor; (2) extraction of sulphur; (3) extraction of ammoniacal salts; (4) preparation of prussian blue.

(1) The liquor contains a little free ammonia (0 to 2 per cent.), which should not be lost. The liquor, therefore, is first desiccated; care being taken to collect the water of condensation. For this purpose, preference is given to an appliance consisting of a cylinder with double jacket and a current of steam circulating between the sides. The liquor to be dried is placed inside the cylinder and agitated during heating by means of paddles mounted on an axial shaft to which rotary motion is given. The steam and the free ammonia are sucked through an orifice in the inner cylinder by a pump, and then sent into a condensing worm.

(2) The sulphur can be extracted by simple dissolution; some volatile solvent, preferably a trichlorethylene one, being used for the purpose. To obtain this dissolution of sulphur, the diffusing apparatus of M. Charles Bonneau is preferably utilized. At the outlet from this diffusing and extracting machine a hot saturated solution of sulphur in the solvent is obtained. It is then allowed to cool, and a large portion of the sulphur is deposited in crystals. The solvent can then be separated for further work, or the liquid distilled to recover the sulpur it still contains in solution.

(3) The residue from the extraction of sulphur is put into a battery of diffusers and drained with tepid water to which the slightly ammoniacal water of condensation from the initial desiccation is added. When the drainage is considered to be sufficient, the liquid charged with ammoniacal salts is treated with lime in an apparatus for collecting ammonia, either in the form of aqueous solution or of salts; the requisite acid elements being added in the usual way. Another method consists in directly treating the mass of gas liquid itself, after extraction of the sulphur, with milk or lime. This operation gives a double result—the disengagement of the ammoniacal nitrogen, and the rendering soluble of the ferrocyanides.

(4) For the extraction of prussian blue the solid residue from the preceding operations is mixed with water and slaked lime. The mass put into large vats is then brought by means of a current of steam to a temperature of about 100° C. Under the action of lime, the ferric ferrocyanide or prussian blue contained in the liquor is transformed into soluble calcium ferrocyanide. It is allowed to deposit, and the liquid is then decanted in separating it from the insoluble part of the gas liquor. This solution is brought to boiling point in vats heated by a current of steam; and then potassium chloride is added. A crystalline precepitate, formed of double ferrocyanide of calcium and potassium, very slightly soluble in water, soon deposits. The precipitate, of considerable greater density than the liquid, quickly collects on the bottom of the vat. After cooling, the liquid is separated from the precipitate by means of a syphon, and the precipitate washed in cold water and decanted a second time. The vat is filled with water and brought to boiling-point; and then it is treated with a slight excess of sodium carbonate. The double ferrocyanide of calcium and potassium is decomposed and there are formed an insoluble calcium carbonate, which precipitates, and an alkaline ferrocyanide, which remains in solution. After cooling, the liquid is separated from the precipitate by decantation. This liquid is then poured into a solution of ferric salt, and there is an abundant precipitate of pure prussian blue or ferric ferrocyanide, which is washed with water and collected in filter-presses. The cakes of prussian blue from the presses are dried in ovens at a temperature of 30° to 35° C.

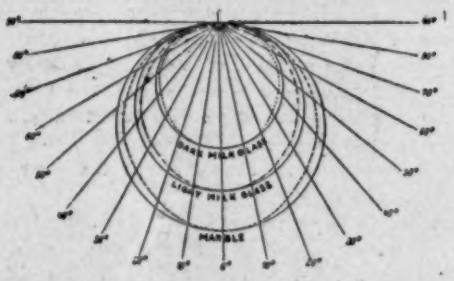
The final solid residue from the gas liquor contains a considerable percentage of iron oxide.

1. *Journal of Gas Lighting.*

New Methods and Appliances.

MARBLE LIGHT SCREENS.—While it has long been known that marble in thin plates is translucent, and that beautiful effects can be obtained with it, the cost of producing thin plates prohibited the employment of marble in lamp casings until a German engineer succeeded in producing marble plates ⅛ inch to ¼ inch thick, more translucent than ordinary milk glass. The plates are polished on both faces and are impregnated with oil at high pressures and temperatures.

In order to determine whether the greater translucency of marble is accompanied by loss in diffusive power, as in the case with ground glass, an aperture in an opaque screen placed upon a Nernst lamp was covered successively with marble and various glasses, and the light transmitted in different directions measured. Dotted lines in the figure represent the diffusion curves. The quantity of light emitted in any direction is proportional to the length of the numbered straight line intercepted by the curve. Each curve is accompanied by the corresponding circle of theoretical diffusion, according to the cosine law, with no loss of light. The close approximation of each curve to its circle shows that the treated marble, like the milk glass, is a good diffusing agent. The curve for ground glass is a long narrow oval, and little light is diffused more than 20° from the normal.



Diffusion Curves.

The translucency was measured by a photometer placed 8 feet in front of a 16 by 16-inch plate, illuminated by an electric bulb 4 inches behind it. Thus, it was found that the marble plate transmitted nearly 40 per cent, while the milk glass transmitted only 17 per cent. of the incident light.

The radiation from an electric bulb was allowed to fall on a vaccum thermo-element connected with a galvanometer. When plates of marble and light and dark milk glass were successively interposed the deflections were proportional to 100, 650, and 360. Hence, though milk glass is less translucent than treated marble for visible rays, it is from 3½ to 6½ more translucent for the total radiation of a carbon filament lamp. As the visible rays are but a small part of the total radiation, it follows that the marble must be very opaque to the infra-red rays, which are not present in diffused daylight, and are probably injurious. The fact that the eyes soon become fatigued when reading or writing by lamp light has been ascribed to the retardation of the flow of retinal pigment by red, yellow and infra-red rays, and Dr. Vogt has found that four-fifths of the radiation that reaches the retina from a carbon filament lamp consists of infra-red rays. Oculists have not yet proved conclusively that infra-red rays actually cause injury or fatigue, but this proof appears from the universal testimony that the "marble light," which is nearly free from these rays, is especially agreeable to the eye. Treated marble seems the best of all substances now available for this purpose. It is even superior to water. Independently of the injurious effect of infra-red rays on the eyes, the elimination of radiant heat is desirable, especially with gas and oil lamps. The reader's head can be brought, without discomfort, two or three times nearer the light when marble is substituted for milk glass.

STRENGTHENED GLASS.—Combined sheets of glass and celluloid are now being extensively used for the wind-screens of motors. A sheet of celluloid is cemented between two sheets of glass, which may be either plate or sheet glass, adhesion secured by considerable pressure, and the product is difficult to break and impossible to shatter. A heavy blow with a hammer will splinter the glass on the side struck, but has little or no effect on the back sheet, and the fragments are held in position by the celluloid sheet to which they are cemented. It is said that the material is a certain preventive of the accidents which occur when a rider in a motor car is flung against a shield.

The drawbacks to its extensive use are its cost and the moderate size in which it can be made. The size of the sheets is limited to 24 inches in one direction and to 58 inches in the other, by the size of the celluloid which can be obtained, but as celluloid is now manufactured in continuous rolls there is practically no limit to its length, and there seems no reason why the width should not be increased. The material is applicable for glazing pictures, for showcases in which valuable articles are exhibited, and for doors of instrument cabinets.

Much greater strength is obtained when the number of sheets of glass and celluloid is increased, and the material is then suitable for such purposes as ship's deck lights, port lights, etc.

The diminution of transparency is considerable, the celluloid being almost, if not quite clear.

Items of Interest
FROM VARIOUS LOCALITIES.

THE Riter-Conley Manufacturing Company has petitioned the Board of Aldermen of Cambridge, Mass., for permission to lay a temporary spur track for handling the material for the new holder which they will build for the Cambridge Gas Light Company.

THE Waynesboro (Pa.) Gas Company has finished a new 8 inch trunk line making connection from the plant to mains covering the southern part of the town. Several thousand feet of new mains have also been constructed, principally in South Waynesboro and on Clayton avenue. These additions have been made to give an ample supply of gas to sections that heretofore have been somewhat limited in equipment. The manufacturing plant of the company has been thoroughly repaired with a view to getting the greatest efficiency possible from the machinery. More extensions are contemplated to mains in the near future.

THE last weekly meeting of the Board of Trade, of Newark, N. J., was full of interest, and nearly 2 hours was consumed in the luncheon and in the discussion on the report of the Gas Committee on the rates charged for gas in Newark. The report was a lengthy one and showed a comparison in prices in the various towns, and the committee came to the conclusion that the rate charged in Newark "is as low and equitable as the rate enjoyed by any other town or city in the State."

A CORRESPONDENT in Boston, Mass., writes: "On last Monday night Superintendent Morrison, of the Brockton Gas Light Company, was presented with an excellent crayon portrait of himself by employees of the company. Mr. Morrison has endeared himself to the men by his square and upright dealings, and the feeling manifested towards him is genuine. Under these circumstances, a token of appreciation is always a becoming thing, and men dignify themselves in the giving."

THE following statistics from the annual report of the Massachusetts gas and electric light Board for the year ended June 30, 1913, show that Holyoke and Westfield have the lowest municipal rate of the four gas plants in the vicinity. The rates of the respective towns and cities follow: Holyoke, $1; Middleboro, $1.66; Wakefield, $1.30; Westfield, $1. The cost of manufacture at Middleboro is $1.75 per 1,000 cubic feet; at Wakefield, $1.48 per 1,000 cubic feet; at Holyoke, $.996 per 1,000 cubic feet; at Westfield, $.888 per 1,000 cubic feet.

ALL the gas now being used in Perth Amboy, N. J., is now supplied from the plant at Elizabeth, from which place it is pumped through the mains at a high pressure. The doubling the capacity and reconstruction of the Perth Amboy works has made it necessary to shut down the old plant for about a month, when the reconstructed works are expected to be ready. Then the Perth Amboy plant will be able to supply all the gas used. Heretofore there was some Elizabeth gas used as the old plant was incapable of supplying the whole city.

MR. R. H. PARKER, for the past 5 years connected with the Fitchburg (Mass.) Gas and Electric Light Company, has resigned his position as office manager, to take effect Sept. 1.

A CABLEGRAM has been received by Arthur E. Childs, President of the Massachusetts Lighting Companies, from Addis M. Whitney, of Swampscott, Treasurer of the Company, who has been for some months with his family on the continent. The cable, dated from Lucerne, states that Mr. Whitney and his family are trying to reach London, and that he is enlisting the interest of the highest authorities in their behalf. He added that the family are all well and requests that his parents and friends be notified of their safety.

CONSOLIDATED Gas Company of New York, has revised its gas oil contract with Standard Oil of New Jersey by contracting to take at least 275,000,000 gallons of gas oil between July 1, 1914, and Dec. 31, 1916. It has agreed to take 100,000,000 gallons of gas oil during calendar year 1914 at 5½ cents a gallon. Gas oil, however, on account of European war and other factors reducing demand and increasing the supply, has declined in value. By agreeing to longer contract the Consolidated Gas Company was to effect a reduction of 2 cents a

gallon, roughly speaking. The saving for last half of calendar year 1914 is approximately $1,000,000, equal to 1 per cent. on Consolidated Gas stock. The saving in 1915–1916 at lower price of gas oil will be $2,000,000 yearly, or 2 per cent. on the stock.

THE gas franchise held by the Birmingham Tuscaloosa Railway and Utilities Company (Tidewater interests), was extended for 12 months by the Tuscaloosa (Ala.) City Commissioners, and an additional forfeit of $1.500, making a total of $4,000, was deposited by the company, guaranteeing the completion of the plant and mains at the specified time.

THE Oshkosh (Wis.) Gas Light Company are now supplying water gas, the change from coal gas being made about the 20th ult. They published this notice: "The gas now furnished in this city will require in some instances a readjustment of the regulator or air mixer. This is a very simple matter. If the gas does not burn satisfactorily it is because of lack of proper adjustment of the regulator. The company is, on its own motion, sending around inspectors to make the adjustments where found necessary.

THE contract for the Virginia (Minn.) municipal gas plant has been awarded to the American Gas Construction Company, of Newton, Ia., on their bid of $58,000. A local notice says: "This city, which already has its own electric light and water plant, will have a gas plant too if the proceedings started by the water and light board recently are not delayed or held up in the courts. The board let the contract for installing the plant to the American Gas Construction Company of Newton, Ia., for $58,000. If court proceedings are not instituted, and it is possible they may be judging by the time the city had acquiring the electric light and water plants, work on the proposed plant will begin in a short time,"

To prevent accidents after dark in Sixteenth street, Washington, D. C., and to so light the street that it will be safe for pedestrians at night, the Washington Gas Light Company recently offered to extend its mains and install posts and powerful lights. The Commissioners are considering the offer, which was contained in the following letter: "In view of the urgent necessity for the lighting of Sixteenth street extended north of the bridge, the Washington Gas Light Company will, without delay, if permission is given, extend its mains on both sides of the street and erect ornamental lamps similar to those now in K street northwest between Ninth and Twenty-second streets. We make this offer in the public interest, as the recent distressing accident has suggested the advisability of prompt and proper illumination of this greatly used thoroughfare."

A PASTEURIZING plant for dairies has been set up in the display rooms of the Laclede Gas Light Company, designed for use by milk producers who comply with St. Louis, Mo., ordinances going into effect April 1, 1915, which require that all milk sold in the city shall be rendered sterile. The use of gas is recemmended to supplant coal fires under the heating device, being more sanitary and cheaper, as the gas is automatically cut off when the water reaches the required temperature. Dirty coal or gaseous coke is thus avoided, and cleanliness achieved. The new milk pasteurizing is one of 1,000 uses to which gas has been put in the trades and industries. Various appliances from broilers, driers and soup kettles, to irons that may be used for pressing without the usual cloth and sponging, are shown in the company's display rooms.

WHETHER a public service corporation can change its method of making collections for service and enforce payment according to such changes by suspending service, will be tested in a suit brought in Indianapolis, Ind., against the Citizens Gas Company. It is charged that the gas company ordinarily sent collectors to plaintiff's establishment, and that it, without notifying him, made a rule that payment should be made at the office of the company. Because he failed to make a payment, Hobensack alleges, his gas was turned off. He demands $2,000 in damages.

BEGUN six months ago by the organization of a Gas Consumers' League, a fight for cheaper gas rates in Atlanta, Ga., has now reached such proportions that an Aldermanic investigating committee has been formed and the issue has become a political one, many leaders of the fight advocating municipal ownership of the Atlanta Gas Light Company, a corporation of 25 years' standing. Candidates for election to the Board of Aldermen in the primaries, held August 19, were face to face with this issue.

THE application of the Winslow Gas Company for permission to issue stock to the amount of $60,000, was heard recently before Commissioner Jones of the Arizona Corporation Commission. The company proposes to install a gas plant at Winslow. Charles M. Lang of Los Angeles, who is President of the company, appeared before the Commission.

AT a regular semi-monthly meeting of the City Council considerable business of importance was transacted. During the meeting a letter was read from Mr. R. L. Ellis, Manager of the Selma (Ala.) Lighting Company, offering to replace the present electric lights on Broad and Water Streets with gas arches. In his letter to the Council Mr. Ellis set forth that the gas arches, with about 250 candle power lights, would make a better "white way" than the present system of lights on those two streets, and that they would cost practically the same. The proposition made to the Council by Mr. Ellis was adopted and the gas arches will be put in during the next month or so.

LOUISVILLE (Ky.) Gas and Electric Company, for week ending Aug. 14, reported contracts taken for industrial gas covering an annual consumption of 1,800,000 cubic feet with a gain of 124 in gas consumers. In the same week the electric department secured 176 customers with 141 kilowatts of lighting and 107 horse power in motors.

ARTICLES of organization for the Badger (Wis.) Gas Appliance Company, capitalized at $10,000, have been filed with Register of Deeds, Bolton. The incorporators are Hans J. Rasmussen, Victor Hanson and Jerome J. Foley. There are 200 shares, each valued at $50. The company will engage in the manufacture of gas appliances.

THE Iowa Gas and Electric Company, of Washington, has recently expended $20,000 in the improvement of its gas service.

T. J. CONDON has resigned his position as Superintendent of the Cairo (Ills.) Gas Company and will leave for Amarillo, Tex., where he will become Superintendent of the gas plant there, effective September 10th. Mr. Condon came to Cairo about 4 years ago from Galesburg, Ill., and has been in the employ of the McKinley system for about 11 years.

BY order of the Public Service Commission (N. Y.) the Long Island Gas Corporation is permitted to purchase the works system, franchise of Henry F. Cook, in the town and village of Southampton, and to issue securities to make extensions and improvements throughout the territory. An issue of $200,000 of the 5 per cent., 25 year, first mortgage bonds, $75,000 common, and $25,000 preferred stock of the Long Island Gas Corporation is authorized. $85,000 of the bonds must be sold for not less than $73,0.0 with which the Sag Harbor property will be purchased. The rest of the bonds must not be sold at less than 85, and the stock at not less than par. With this sum high pressure trunk line and equipment will be installed from Sag Harbor to Southampton, from Bridgehampton to East Hampton. Distribution lines will be installed in these communities and improvements to generators and existing lines throughout the territory will be made.

JOHN S. NAYLOR, President of the Northern Liberties (Phila.) Gas Works and until recently proprietor of an iron foundry at Front street and Girard avenue, died suddenly at Rockland Breakwater, Me. He had gone to the summer resort with his wife several months ago, hoping to regain his health, which had been failing for some time. Mr. Naylor was a director of the National Bank of the Northern Liberties, for several years, and was the son of the late Jacob Naylor, an extensive manufacturer of ironware. He lived at 201 West Chestnut avenue, Chestnut Hill. He was a member of the Union League.

PARKER H. KENBLE, Manager of the Electrical Commercial Department of the Union Gas and Electric Company, Cincinnati, O., has resigned because of bad health. The officials of the gas company have decided to combine the gas commercial and the electrical commercial departments with Mr. H. J. Hoover, the present manager of the commercial gas department, in charge of the combined departments.

SEA GIRT, N. J., residents are rejoicing over the fact that they are soon to have gas. The Coast Gas Company, of Belmar, is extending its mains from Spring Lake through Sea Girt, and property owners will soon connect with the new line. A large force of workmen are employed on the work, which is moving along rapidly.

Utilities Commission News.

PACIFIC BONDS.—Directors of the Pacific Gas and Electric Company have applied to the California Railroad Commission for authority to issue $1,000,000 general and refunding bonds to be used as additional security to be filed with the Federal court in connection with the controversy over the reduction made in gas rates by the Board of Supervisors of San Francisco. The security is to provide for reimbursements of gas consumers should the company lose in its suit against the city over the reduced rate.

YOUNGSTOWN COMPANY SOLD.—The Ohio Utilities Commission has authorized the Youngstown and Sharon Street Railway Co., to purchase all the property of the Youngstown Consolidated Gas and Electric Co. The consideration is $4,380,000, representing the stocks and bonds of the gas company and its surplus, and is to be paid by a demand note without interest. The gas and electric company is to be dissolved and all securities called in and destroyed in public. This was part of the order of the commission.

AN ADDITIONAL COMMISSION.—At the next session of the North Carolina Legislature an effort will be made to create another commission to look after the corporation affairs of the State and the regulation of public utilities. The present State corporation commission, composed of 3 members, has, it is thought, more work to do than it ought to have, and the intention of the second commission promoters is to make it the duty of either the new or the old commission to look exclusively after railway matters. At present the corporation commissioners constitute the tax rate commission also. It is the purpose to relieve them of this work also.

PETITION OF CITIZENS GAS COMPANY.—The Indiana Public Service Commission has postponed action on the petition of the Board of Public Works to compel the Citizens Gas Company, of Indianapolis to lay main extensions at once in streets that are to be improved permanently this year. The delay is due to the absence from this city of J. D. Forrest, General Manager of the Citizens Gas Company. The gas company already has done as much extension work as it is required to do under its franchise with the city, but the works board is trying to compel it to install mains in all the streets that will be paved in the autumn, so that it will not be necessary later to tear away the pavement.

OKLAHOMA REPORT.—The sixth annual report of the Oklahoma Corporation Commission shows that the Commission during the year ending June 30, 1914, considered 184 formal and 3,600 informal complaints on matters within its jurisdiction. Much of the report bears on the efforts of the State to establish the 2 cent passenger fare rate and on matters of legislation. "In our last annual report we recommended certain legislation," said the Commission, "which was by your Excellency submitted to the Legislature for its consideration. The Legislature passed laws substantially carrying out the recommendations of the Commission on all subjects except the regulation of issuance of securities on public service properties. It now appears that Congress may pass a general law regulating the securities of all public service properties engaged in interstate business. If such action should be taken by the National Government there would appear to be no necessity for the State enacting what is known as a stock and bond law, covering utilities doing an interstate business. We recommend that the next Legislature enact a law conferring jurisdiction upon the Commission to regulate and limit the amount of stock and bond issues for all public utilities whose property is wholly within the State of Oklahoma, and not engaged in transportation of commodities interstate, and should Congress fail to enact a law to regulate the stock and bond issues of carriers interstate, we here repeat our recommendation that this State should pass a law similar to those of many other States."

STATE COMMISSION FOR UTAH.—Planks favoring the creation of a public utilities commission for the State of Utah were included in the platforms of the Democratic and Progressive parties, which recently held their State conventions in Salt Lake City. The two parties have fused in Utah, naming a ticket including half Democrats and half members of the Progressive party. Both conventions unanimously adopted the public utilities plank and the two parties promise that if the combined ticket is elected in Utah next fall a public utilities commission will be created. The question of a creation of a public utilities commission has been considered by the Utah Legislature several times, but bills providing for a commission have always been killed.

Financial Notes.

PACIFIC Gas and Electric reports for July:

	1914.	Increase.
Gross revenue	$1,350,322	$140,730
Net revenue	613,184	212,734
Balance after bond interest and discount	276,611	205,114
Seven months ending July 31—		
Gross revenue	9,938.313	681,443
Net revenue	4,801,222	943,970
Balance after bond interest and discount	2,444,482	877,068
Twelve months ending July 31—		
Gross revenue	16,883,780	1,371,404
Net revenue	7,815,101	1,410,794
Balance after bond interest and discount	3,817,510	1,283,656

THE combined net earnings available for dividends of the subsidiary companies of the Massachusetts Gas Companies for July, the first month of current fiscal year, were $187,106, an increase of $17,736, or 10.47 per cent., as compared with the corresponding month a year ago. July earnings compare as follows:

	1914.	1913.
Gas department—		
Boston	$75,986	$59,174
East Boston	12,012	3,898
Quincy	4,010	3,917
Newton	2,743	1,485
Coal department—		
N. E. gas	54,210	54,347
N. E. coal	26,432	40,036
Federal coal	7,834	2.935
Tow boat	3,876	3,515
Total	$187,106	$169,363

Increases in gas outputs for July compared with increase for corresponding month in 1913, as follows (in per cent.):

	1914.	1913.
Boston	8.94	4.12
East Boston	12.88	13.39
Quincy	9.70	18.82
Newton	11.95	11.64

THE Cities Service Company has sent a circular letter to stockholders calling attention to the creation of a new reserve fund equal to 10 per cent. of the company's net earnings available for stock. The fund is in addition to the regular maintenance allowances. At a meeting of the Board recently it was decided that present conditions did not warrant any immediate action beyond that previously taken with respect to the payment of dividends. Of this action the latter says: "Since our last communication various shareholders have written to inquire how the war in Europe can effect the payment of dividends by this company. Public utility properties are required continually to extend their service to meet the natural growing demands of their communities. Capital for these requirements is provided ordinarily from the surplus earnings and by the sale of new securities. Under existing conditions, when all the security markets are closed, the Cities Service Company must be prepared to meet all capital requirements out of the income of its properties. Your directors believe that the measures put into effect strengthen the position of the company and fortify the investment of the stockholders.

THE net earnings in the New Bedford (Mass.) Gas and Edison Light Company from the sale of gas and electricity during the past year, after deducting $75,000 for depreciation were $114,399.69. Dividends paid were $135,150. These were the results of the year's operation as disclosed at the annual meeting of the stockholders to-day. The profit and loss account showed a decrease of $26,406.79, from $490,015.33 to $463,608.54. Earnings were less than anticipated because of the unusually high price of oil used for water gas, and extraordinary expenses incurred in connection with electric work during the rebuilding of the station and the revamping of the street system.

H. F. MCCONNELL & Co., dealers in public service securities, New York, state: "No quotations are obtainable, nor, in view of the many bank loans in various cities, is it wise to establish a price that in any way has a bearing on intrinsic values. Public utility securities have not acted in any way to cause alarm. Very little stock was offered down, and there seems to have been a buyer on every concession. The passing of the monthly dividend by the Cities Service Company has worried some of the stockholders, but under the circumstances was the proper action to take. This act, however, shows the weakness of the international markets and adds to the strength of those companies that have confined their financing to American institutions and the American public. During the past week we have interviewed the heads of practically all the large public utility companies and have been informed that no change in dividend policy is contemplated. Neither will there be any change in the price of their commodities. We feel that this is a time for every security holder to figure on the intrinsic value of his investment holdings and add to them as circumstances will permit."